THE WORKS OF ARISTOTLE

TRANSLATED INTO ENGLISH UNDER
THE EDITORSHIP OF

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OPUSCULA

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NOTE

Professor J. A. Smith has retired from the position of joint-editor of this series, but will act as a general adviser.

The Index has been made by Messrs. Forster and Loveday, with the aid (as regards the *De Mirabilibus Auscultationibus*) of Mr. Dowdall.

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Feb. 1913.

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DE COLORIBUS

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PREFACE

Both the method and the style of this treatise are unlike Aristotle's, and its contents differ considerably from his known views. But it is very likely a Peripatetic product, and has been ascribed (though without much probability) to Theophrastus, as also to the convenient Strato. Prantl's *Aristoteles über die Farben* (1849) has, of course, been of great use to us, and his text in the Teubner edition (1881) has in the main been followed.

We take this opportunity of expressing our obligation to Mr. W. D. Ross for many valuable suggestions.

T. L.
E. S. F.

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CHAP.

DE COLORIBUS

1 Simple colours are the proper colours of the elements, i.e. of fire, air, water, and earth. Air and water when pure are by nature white, fire (and the sun) yellow, and earth is naturally white. The variety of hues which earth assumes is due to coloration by tincture, as is shown by the fact that ashes turn white when the moisture that tinged them is burnt out. It is true they do not turn a pure white, but that is because they are tinged afresh, in the process of combustion, by the smoke, which is black. And this is the reason why lye-mixture turns yellow, the water being coloured by hues of flame and black.[1] 791[a]

Black is the proper colour of elements in process of transmutation. The remaining colours, it may easily be seen, arise from blending by mixture of these primary colours.

Darkness is due to privation of light. For we see black under three different conditions. Either (1) the object of vision is naturally quite black[2] (for black light is always reflected from black objects); or (2) no light at all passes to the eyes from the object (for an invisible object surrounded by a visible patch looks black); and (3) objects

[1] 791[a] 8, 9. This apparently must mean that the yellow of κονία is a mixture, due to colours received from heating and from black smoke. But as we have just learned that yellow is a simple colour, the passage is suspicious.

[2] 791[a] 14. Omitting μή with Coel. Calcagninus in his translation. From ll. 9, 10 we learn that black is due to transmutation of elements. Prantl points out that there is no difference, if the text is right, between the cases of τὸ μὴ ὁρώμενον and ἀφ' ὧν μηδὲν κτλ. and that τὸ γὰρ μὴ ὁρώμενον in l. 16 must refer to both. He therefore takes the case of transmutation to be a first condition, here supplied in thought only, and the ἤ in l. 15 to mean 'or in other words', so that τὸ μὴ ὁρώμενον and ἀφ' ὧν μηδὲν κτλ. together constitute the second condition. But the explanatory sentences ἁπάντων γὰρ κτλ. and τὸ γὰρ μὴ κτλ., being separate, seem to show that ἤ . . . ἤ introduce two distinct conditions. We therefore take τὸ ὁρώμενον which is φύσει μέλαν to refer to transmutation of elements.

always appear black to us when the light reflected from them is very rare and scanty. This last condition is the reason why shadows appear black. It also explains the blackness of ruffled water, e.g. of the sea when a ripple passes over it: owing to the roughness of the surface few rays of light fall on the water and the light is dissipated, and so the part which is in shadow appears black. The same principle applies to very dense cloud, and to masses of water and of air which light fails to penetrate: for water and air look black when present in very deep masses,
791b because of the extreme rarity[1] of the rays reflected, the parts of the mass between the illuminated surfaces being in darkness and therefore looking black. There are many arguments to prove that darkness is not a colour, but merely privation of light, the best being that darkness, unlike all other objects of vision, is never perceived as having any definite magnitude or any definite shape.

Light is clearly the colour of fire; for it is never found with any other hue than this, and it alone is visible in its own right, whilst all other things are rendered visible by it. But there is this point to be considered, that some things,[2] though they are not in their nature fire nor any species of fire, yet seem to produce light. So we cannot say in the same breath, 'The colour of fire is identical with light, and yet light is the colour of other things besides fire,' but we can say, 'This hue is to be found in other things besides fire, and yet light is the colour of fire.' Anyhow, it is only by aid of light that fire is rendered visible, just as all other objects are made visible by the appearance of their colour.

The colour black occurs when air and water are thoroughly burnt by fire, and this is the reason why burning objects turn black, as e.g. wood and charcoal when the fire is put out, and smoke from clay[3] as the moisture is gradually secreted and burnt. This is also why the blackest smoke is given off by fat and greasy substances like oil and pitch and resinous wood, because these objects burn most com-

[1] 791a27. Cf. 794a 11–14.
[2] 791b 10. *Sc.* phosphorescent objects.
[3] 791b 20. *Sc.* in a kiln.

pletely, and the process of combustion is most continuous in them.

Again, things turn black through which water percolates, if they first become coated with lichen and then the moisture dries off. The stucco on walls is an example of this, and much the same applies to stones under water, which get 792a
covered with lichen and turn black when dried.

This then is the list of simple colours.

2 From these primary colours the rest are derived in all their variety of chromatic effects by blending of them and by their presence in varying strengths.[1] The different shades of crimson and violet depend on differences in the strength of their constituents, whilst blending is exemplified by mixture of white with black, which gives grey. So a dusky black mixed with light gives crimson. For observation teaches us that black mixed with sunlight or firelight always turns crimson, and that black objects heated in the fire all change to a crimson colour, as e.g. smoky tongues of flame, or charcoal when subjected to intense heat, are seen to have a crimson colour. But a vivid bright violet is obtained from a blend of feeble sunlight with a thin dusky white. That is why the air sometimes looks purple at sunrise and sunset, for then these conditions are best realized, the air being dusky and the impinging rays feeble. So, too, the sea takes a purple hue when the waves rise so that one side of them is in shadow: the rays of the sun strike without force on that slope and so produce a violet colour. The same thing may also be observed in birds'

[1] 792a 4. τῷ μᾶλλον καὶ ἧττον. In 792a 3–9 it seems that differences of 'degree' are identical with differences τῷ πλήθει καὶ ταῖς δυνάμεσι. One might translate by 'differences in saturation' if this did not imply varying amounts of colourless light, such as are distinguished from differences of degree by 793a 1–5. The vaguer word 'strength' seems preferable. But the example of crimson and violet is obscure. It cannot be meant that the difference between these colours depends on differences of strength in their constituents, for we are to learn that they have different constituents. The meaning may be either that differences in the strength of these colours affect their derivatives, which ought not to be mentioned until the discussion of tertiary colours later on in this chapter, or, as in the rendering above, that different shades of each of these colours depend on the strength of their respective constituents, when strictly it should not be mentioned until chap. 3.

wings, which get a purple colour if extended against the light, but if the amount of light falling on them is diminished the result is the dark colour called brown, whilst a great quantity of light blended with primary black gives crimson. Add vividness and lustre, and crimson changes to flame-colour.

For [1] it is after this fashion that we ought to proceed in treating of the blending of colours, starting from an observed colour as our basis and making mixtures with it. (But we must not assign to all colours a similar origin,[2] for there are some colours which, though not simple, bear

[1] 792^{a} 29–^{b} 32. The text of this passage is probably beyond repair, and the meaning is very doubtful. The rendering above assumes alterations of *πρός* to *πως* before *μίξιν* in l. 34 (with Prantl); of 792^{b} 1 to *καὶ τὸ μὴ εὔσημον ἐν τῷ παντὶ δεῖ πρὸς τὸ τεθεωρημένον κτλ.*; of *καὶ μὴ . . . ποιεῖν* in ll. 4–5 to *εἰ καὶ μὴ . . . ποιεῖ*; and of *ἠεροειδεῖς* in l. 8 to *ἡλιωδεῖς, τοῦ ἡλίου*, or some such words; and also the rejection of Prantl's *μή* in l. 2 and his *μιμήσεως* in l. 12, and the omission of *καί* in l. 14. But the words *πως* (or *πρὸς*) *μίξιν ἑνὸς ἔχειν* are probably corrupt. With *πρός* they are untranslatable. With *πως* they can have only the meaning given above, for they cannot mean that a simple colour may be called a mixture in a sense of one colour, viz. itself, for then a simple colour will not have the same relation either to itself or to a secondary colour like crimson that crimson has to a tertiary colour; for crimson to produce a tertiary colour must be mixed with a colour not itself, and if mixed with itself does not give a tertiary colour. If 792^{b} 1 is not emended, it must mean that the relation which secondary colours bear to tertiary is not so easily established in the tertiary product as the relation of primary colours to secondary in the secondary. This involves a forced construction, but if *εὔσημον* is taken as the object of *κατασκευάζειν*, then whether you supply *μίξιν* or *χρῶμα* the result is nonsensical, for it is not the product which is obscure, but its constituents. Thus some emendation seems necessary. In the next sentence Prantl inserts *μή* after *ἀνάγκῃ*, in which case it would seem necessary to emend *ἔμφασιν*, perhaps to *ἐμφάνισιν*. But it seems possible to translate without *μή*, if the emendation of *εἰ καὶ μὴ . . . ποιεῖ* is accepted, the stress of the argument falling on similarity of origin of colours in mixture and not on difference according as they are or are not derived directly from primary colours.

In the sentence 792^{b} 5–11 it is evident that *ἠεροειδεῖς* is not genuine. It makes no sense, and in all other passages (793^{b} 5, 794^{a} 4, 795^{b} 19, 797^{a} 7) the form used is *ἀεροειδής*. Possibly the reading should be *ἡλιωδεῖς*, which gives a sense consonant with the rest of the treatise, as long as it is remembered that wine colour (which is a tertiary colour) requires not only sunlight and black but also crimson as its constituents. Cf. 795^{b} 28. It is possible that *φοινικῷ χρώματι* or some such words should be inserted after *στίλβοντι*. It is also clear that *ἅλουργες* in l. 10 is used loosely, for it is a secondary colour, and not strictly equivalent to *οἰνωπόν*.

[2] 792^{a} 29. *Sc.* directly from simple colours.

the same relation to their products[1] that simple colours bear to them,[2] inasmuch as a simple colour has to be mixed with one other colour to produce them.[3]) And when the 792b
constituents are obscure in the compound product, we must still try to establish our conclusions by reference to observation. For,[4] whether we are considering the blend which gives (say) violet or crimson, or whether we are considering the mixtures of these colours which produce other tints, we must explain their origin on the same kind of principles,[5] even though they look dissimilar. So we must start from a colour previously established, and observe what happens when it is blent. Thus we find that wine colour results from blending rays of sunlight with pure lustrous black, as may be seen in grapes on the bunch, which grow wine-coloured as they ripen; for, as they blacken, their crimson turns to a violet. After the manner indicated we must treat all differences of colours, getting comparisons by moving coloured objects,[6] keeping our eye on actual phenomena, assimilating different cases of mixture on the strength of the particular known instances in which a given origin and blending produce a certain chromatic effect,[7] and verifying our results. But we must not proceed in this inquiry by blending pigments as painters do, but rather by comparing the rays reflected from the aforesaid known colours, this being the best way of investigating the true nature of colour-blends. Verification from experience and observation of similarities are necessary, if we are to arrive at clear conclusions about the origin of different colours, and the chief ground of similarities is the common origin

[1] 792a 33. *Sc.* tertiary colours.

[2] 792a 34. *ἑαυτά*. *Sc.* the secondary colours.

[3] 792a 34. Understand, 'and they have each to be mixed with another colour to produce the tertiary colours.'

[4] 792b 2. Understand, 'though we must not try to derive all colours directly from simple.'

[5] 792b 3. *ὁμοίως*. i.e. 'from an observed colour.'

[6] 792b 12. *ἐκ κινήσεως*. i.e. from moving coloured objects in different lights or in different positions to the light, as Schneider suggests. Prantl's emendation, *μιμήσεως*, is at least as unlikely as the traditional text.

[7] 792b 14. Omit *καί* with Schneider. As Schneider says, *τὰ κατὰ μέρος κτλ.*, and *τὰ εἰρημένα* in l. 18, are in the last resort the simple primary colours.

of nearly all colours in blends of different strengths of sunlight and firelight, and of air and water. At the same time we ought to draw comparisons from the blends of other colours, as well as the primary, with rays of light. Thus charcoal and smoke, and rust, and brimstone, and birds' plumage blent, some with firelight and others with sunlight, produce a great variety of chromatic effects. And we must also observe the results of maturation in plants and fruit, and in hair, feathers, and so on.

We must not omit to consider the several conditions 3
which give rise to the manifold tints and infinite variety of colours. It will be found that variations of tint occur :
793a (1) Because colours are introcepted by varying and irregular strengths of light and shade.[1] For both light and shade may be present in very different strengths, and so whether pure or already mixed with colours they alter the tints of the colours they introcept.

Or (2) because the colours blent vary in fullness and in effectiveness.

Or (3) because they are blent in different proportions.

Thus violet and crimson and white and all colours vary very much both in strength and in intermixture and purity.

(4) Difference of hue may also depend on the relative brightness and lustre or dimness and dullness of the blend. Lustre is simply continuity and density of light ; e.g. we have a glistening gold colour when the yellow colour of sunlight is highly concentrated and therefore lustrous. That explains why pigeons' necks and drops of falling water look lustrous when light is reflected from them.

Again, (5) some objects change their colour and assume a variety of hues when polished by rubbing or other means, like silver, gold, copper, and iron, when they are polished ; and some kinds of stones give rise to different colours,

[1] 793a 1 ff. It may be doubted whether λαμβάνεσθαι is genuine. If there is any difference of meaning between *ἀνίσως* and *ἀνωμάλως*, the former will refer to successive admixtures of a colour with different strengths of light or of shade, the latter to simultaneous admixture of different parts of a stretch of colour with such different strengths.

like . . .[1] which are black but make white marks. This is because the original composition of all such substances is of small dense and black particles, but in the course of their formation they have been tinged, and all the pores through which the tincture passed have taken its colour, so that finally the whole material appears to be of that colour. But the dust that is rubbed off from them loses this golden or copper colour (or whatever the hue may be), and is quite black, because rubbing breaks up the pores through which the tincture passed, and black is the original colour of the substance.[2] The other colour is no longer apparent because the colouring matter is dissipated, and so we see the original natural colour of the material, and this is why these substances all appear black. But when rubbed against a smooth and even surface, as e.g. against a touchstone, they 793b lose their blackness and get back their other colour, which comes through where the lines of the tincture in the pores are unbroken and continuous.[3]

(6) In the case of objects burning, dissolving, or melting in the fire, we find that those have the greatest variety which are dark in colour and give off a thin hazy smoke, such as the smoke of brimstone or rusty copper vessels, and those which, like silver, are dense and smooth.

(7) Apart from these cases, variety of hue is characteristic of all dark smooth objects, such as water, clouds, and birds' plumage. For these last, owing to their smoothness and the variety of blends into which the impinging rays of light enter, show various colours, as also does . . .[4]

(8) Lastly, we never see a colour in absolute purity: it is always blent, if not with another colour, then with rays of light or with shadows, and so it assumes a new tint. That is why objects assume different tints when seen in

[1] 793a 20, 21. The name of the stone has dropped out. Galactites, slate, and other substances have been suggested. Prantl rightly observes that the argument requires *λαμβάνουσι* in place of *γράφουσι*.

[2] 793a 30. The text is corrupt, but the general sense is plain. Perhaps *φύσει δὲ τοιοῦτον* [*sc. μέλαν*] *εἶναι*.

[3] 793b 2. Reading *τῇ τῆς βαφῆς διαφαινομένην*. It seems plain that *συνεχείᾳ* must refer to the pores, in contrast to *ἀναρρήγνυσθαι* above.

[4] 793b 12. As Prantl says, *σκότος* is certainly corrupt, and the name of some smooth dark substance has dropped out.

shade and in light and sunshine, and according as the rays of light are strong or weak, and the objects themselves slope this way or that, and under other differential conditions. Again, they vary when seen by firelight or moonlight or torchlight, because the colours of those lights differ somewhat. They vary also in consequence of mixture with other colours, for when coloured light passes through a medium of another colour it takes a new tinge. For if light falls on a given object and is coloured by it (say) crimson or herb-green, and then the light reflected from that object falls on another colour, it is again modified by this second colour, and so it gets a new chromatic blend. This happening to it continuously, though imperceptibly, light when it reaches the eye may be a blend of many colours, though the sensation produced is not of a blend but of some colour predominant in the blend. This is why objects under water tend to have the colour of water, and why reflections in mirrors resemble the colour of the mirrors, and we must suppose that the same thing happens in the case of air. Thus all hues represent a threefold mixture of light, a trans-
794a lucent medium (e.g. water or air), and underlying colours from which the light is reflected. A translucent white medium, when of a very rare consistency, looks hazy in colour; but if it is dense, like water or glass, or air when thick, a sort of mist covers its surface, because the rays of light are inadequate at every point on it owing to its density, and so we cannot see the interior clearly. Air seen close at hand appears to have no colour, for it is so rare that it yields and gives passage to the denser rays of light, which thus shines through it; but when seen in a deep mass it looks practically dark blue. This again is the result of its rarity, for where light fails the air lets darkness through. When densified, air is, like water, the whitest of things.

Coloration may also be due to a process of tincture 4
or dyeing, when one thing takes its hue from another. Common sources of such coloration are the flowers of plants and their roots, bark, wood, leaves, or fruit, and again, earth, foam, and metallic inks. Sometimes colora-

tion is due to animal juices (e.g. the juice of the purple-fish, with which clothes are dyed violet), in other cases to wine, or smoke, or lye mixture, or to sea-water, as happens, for instance, to the hair of marine animals, which is always turned red by the sea. In short, anything that has a colour of its own may transfer that colour to other things, and the process is always this, that colour leaving one object passes with moisture and heat into the pores of another, which on drying takes the hue of the object from which the colour came. This explains why colour so often washes out: the dye runs out of the pores again. Furthermore, steeping material to be dyed in different astringent solutions during the dyeing produces a great variety of hues and mixtures, and these are also affected by the condition of the material itself, in much the same way that blending of colours was shown in the last chapter to be affected. Even black fleeces[1] are used for dyeing, but they do not take so bright a colour as white. The reason is that whilst the pores of the wool are tinged by the dye that enters them, the intervals of solid hair between the pores do not take 794b
the colour, and if they are white, then in juxtaposition to the colour of the pores they make the dye look brighter, but if they are black, they make it look dark and dull. For the same reason a more vivid brown is obtained on black wool than on white, the brown dye blending with the rays of black and so looking purer. For the intervals between the pores are too small to be separately seen, just as tin is invisible when blent with copper in bronze; and there are other parallel cases.

These then are the reasons for the changes in colour produced by dyeing.

5 As for hair and feathers and flowers and fruit and all plants, it is abundantly clear that all the changes of colour which they undergo coincide with the process of maturation. But what the origins of colour in the various classes of plants are, and what kinds of changes these colours undergo, and from what materials these changes are derived, and

[1] 794a 32. Prantl's *τὰ λευκὰ καί*, though possible, is unnecessary.

the reasons why they are thus affected, and any other difficulties connected with them—in considering all these questions we must start from the following premises. In all plants the original colour is herb-green; thus shoots and leaves and fruit begin by taking this colour. This can also be seen in the case of rain-water; when water stands for a considerable time and then dries up, it leaves a herb-green behind it. So it is intelligible why herb-green is the first colour to form in all plants. For all water in process of time first turns yellow-green on blending with the rays of the sun; it then gradually turns black, and this further mixture of black and yellow-green produces herb-green. For, as has already been remarked, moisture becoming stale and drying up of itself turns black. This can be seen, for example, on the stucco of reservoirs; here all the part that is always under water turns black, because the moisture, as it cools, dries up of itself, but the part from which the water has been drawn off, and which is exposed to the
795a sun, becomes herb-green, because yellow mingles with the black. Moreover, with the increasing blackness of the moisture, the herb-green tends to become very deep and of a leek-green hue. This is why the old shoots of all plants are much blacker than the young shoots, which are yellower because the moisture in them has not yet begun to turn black. In the older shoots, the growth being slow and the moisture remaining in them a long time, owing to the fact that the liquid, as it cools, turns very black, a leek-green is produced by blending with pure black. But the colour of shoots in which the moisture does not mix with the rays of the sun, remains white, unless moisture has settled in them and dried and turned black at an earlier stage. In all plants, therefore, the parts above ground are at first of a yellow-green, while the parts under the ground, namely the lower portions of the stalks and the roots, are white. The shoots, too, are white as long as they are underground, but if the earth be removed from round them, they turn herb-green; and all fruit, as has been already said, becomes herb-green at first, because the moisture, which passes through the shoots into it, has a natural tendency to assume

this colour and is quickly absorbed to promote the growth of the fruit. But when the fruit ceases to grow because the liquid nourishment which flows into it no longer predominates, but the moisture on the contrary is consumed by the heat—then it is that all fruit becomes ripe; and the moisture already present in it being heated by the sun and the warmth of the atmosphere, each species of fruit takes its colour from its juice, just as dyed material takes the hue of the colouring matter in which it is steeped. This is why fruits colour gradually, those parts of them which face the sun and heat being most affected; it is also the reason why all fruits change their colour with the changing seasons. This explanation agrees with the observed facts; for all fruits, as soon as they begin to ripen, change from herb-green to their normal proper colour. They become white and black and grey and yellow and blackish[1] and dusky and crimson and wine-coloured and saffron—in fact, assume **795b**
practically every variety of colour. Since most hues are the result of the blending of several colours, the hues of plants must certainly also be due to the same blends; for the moisture percolating through the plants washes and carries along with it all the ingredients on which their colours depend. When this moisture is heated up by the sun and the warmth of the atmosphere at the time of the ripening of the fruit, each of the colours forms separately, some quickly and some slowly. The same thing happens in the process of dyeing with purple; when, after breaking up the shell and extracting[2] all the moisture from it, they pour it into earthenware vessels and boil it, at first no definite colour is noticeable in the dye, because, as the liquid boils more and more and the colours still remaining in the vessels mix together, each of the hues gradually undergoes a great variety of alterations; for black and white and brown and hazy shades appear, and finally the dye all turns purple, when the colours are sufficiently boiled

[1] 795a 33. μελανοειδεῖς should perhaps be omitted; it is apparently a ἅπαξ λεγόμενον and has come into the text from μέλανες above and σκιοειδεῖς following.

[2] 795b 13. The MSS. vary between ἐκκλύσωσι and ἐκλύσωσι (here adopted).

up together; so as a result of the blending no other colour is separately noticeable. This is just what happens with fruit. In many instances, because the maturing of all the colours does not take place simultaneously, but some colours form earlier and others later, changes from one to another take place, as in the case of grapes and dates. Some of these are crimson at first; but when black colour forms in them, they turn to a wine colour, and in the end they become of a dark-bluish hue, when the crimson is finally mixed with a large quantity of pure black. For the colours which appear late, when they predominate, change the earlier colours. This is best seen in black fruits;
796a for, broadly speaking, most of them, as has already been remarked, first change from herb-green to a pinkish shade and become reddish, but quickly change again from the reddish hue and become dark blue because of the pure black present in them. The presence of crimson is proved by the fact that the twigs and shoots[1] and leaves of all such plants[2] are crimson,[3] because that colour is present in them in large quantities; while that black fruits partake of both colours[4] is clear from the fact that their juice is always of a wine colour. Now the crimson hues come into existence at an earlier stage in growth than the black. This is clear from the fact that pavement upon which there is any dripping, and, generally speaking, any spot where is a slight flow of water in a shady place, always turn first from herb-green to a crimson colour, and the pavement looks as though blood had lately been shed over all the portion of it on which the herb-green colour has matured; then finally this also becomes very black and of a dark-bluish colour. The same thing happens in the case of fruit. That change in the colour of fruit occurs by the formation of a fresh colour, which ousts the earlier one, can easily

[1] 796a 5. Reading with Prantl ἔρνη. Three MSS. read ἔρνα; Bekker, following the rest, reads ἔρια, which is impossible, because τῶν τοιούτων must refer to μελάνων καρπῶν, 795b 32.

[2] *ib.* i.e. those which have black fruit.

[3] 796a 6. Reading with Prantl φοινικιᾶ for μέλανα: a second colour is clearly implied by ἀμφοτέρων, l. 7.

[4] 796a 8. i.e. crimson and black.

be seen from the following examples. The fruit of the pomegranate and the petals of roses are white at first, but in the end, when the juices in them are beginning to be tinged as they mature, they alter their colours and change to violet and crimson hues. Other parts of plants have a number of shades, for example the juice of the poppy and the scum of olive oil; for this is white at first, as is the fruit of the pomegranate, but, after being white,[1] it changes to crimson, and finally mingling with a large quantity of black it becomes of a dark-bluish hue. So, too, the petals of the poppy are crimson at their ends, because the process of maturation takes place quickly there, but at their base they are black, because this colour is already predominant at that end; just as it predominates in the **796b**
fruit, which also finally becomes black.

In the case of plants which have only one colour—white, for example, or black or crimson or violet—the fruit always keeps a single kind of colour, when once it has changed from herb-green to another colour. Sometimes the blossoms are of the same colour as the fruit—as, for instance, in the pomegranate, the fruit and blossoms of which are both crimson; but sometimes they are of very dissimilar hues—as, for example, in the bay-tree and the ivy, whose blossoms are always yellow, but their fruit respectively black and crimson. The same is true of the apple-tree; its blossom is white with a tinge of pink, while its fruit is yellow. In the poppy the flower is crimson, but the fruit may be black or white, according to the different time at which the juices present in the plant ripen. The truth of the last statement can be seen from many examples; for, as has been said, some fruits come to differ greatly as they ripen. This is why the peculiar odours and flavours of flowers and fruits differ so much. This effect of the time of ripening is still more evident in the actual blossoms. For part of the same petal may be black and part crimson, or, in other cases, part white and part purplish. The best example of all is the iris; for its blossom shows a great variety of hues

[1] 796a 29. *λευκανθείς* is perhaps to be suspected, and may be due to λευκός; possibly *ἀποχρανθείς* should be read, cp. l. 24.

according to the different states of maturation in its different parts, just as grapes do when they are already ripening. Therefore the extremities of blossoms always ripen most completely, whilst the parts near the vital principles of the plant have much less colour; for in some cases the moisture is, as it were, burnt out before the blossom undergoes its proper process of maturation. It is for this reason that the blossoms remain the same in colour, while the fruit changes as it grows riper; for the former, owing to the presence of
797a only a small amount of nutriment, soon over-mature, while the fruit, owing to the presence of a large quantity of moisture, changes as it ripens to all the various hues which are natural to it. This can also be seen, as has already been remarked, in the process of colour-dyeing. When in dyeing purple they put in the colouring matter from the vein of the purple-fish,[1] at first it turns brown and black and hazy; but when the dye has been boiled sufficiently, a vivid, bright violet appears. So it must be from similar reasons that the blossoms of a plant frequently differ in colour from its fruit, and that some pass to a stage beyond, whilst others never attain to their natural colour, according as they do or do not mature thoroughly. For these reasons, then, blossoms and fruit differ from one another in their colouring. The leaves of most trees turn yellow in the end, because, owing to the failure of nutriment, they become dried up before they change to their natural colour; just as some of the fruits also which fall off are yellow in colour, because here too nutriment fails before they mature. Furthermore, corn and in fact all plants turn yellow in the end. This change of colour is due to the fact that the moisture in them no longer turns black owing to the rapidity with which it dries up. As long as it turns black and blends with the yellow-green, it becomes herb-green, as has already been said; but, since the black is continually becoming weaker, the colour gradually reverts to yellow-green and

[1] 797a 6. Reading with Schneider *αἱματίτιδας* for *αἱματίδας*. He annotates: '*αἱματῖτις* dici solet, intellecto *φλέψ*. Aristoteles *φλέβα* dixit, alii *σάρκα*, ubi sanies continetur ad purpurae tincturam apta.' Cf. Aristot. *H. A.* v. 15, 547a 19.

finally becomes yellow. The leaves of the pear-tree and the arbutus and some other trees become crimson when they mature; but the leaves even of these, if they dry up quickly, turn yellow, because the nutriment fails before maturity is reached. It seems very probable then that the differences of colour in plants are due to the above causes.

6 The hairs, feathers, and hides, whether of horses, cattle, sheep, human beings, or any other class of animals, grow white, grey, reddish, or black for the same reason. They 797b
are white when the moisture which contains their proper colouring is dried up in the course of maturation. They are black, on the other hand—as was the case in the other form of life[1]—when, during their growth, the moisture present in the skin settles and becomes stale owing to its abundance, and so turns black; in all such cases skin and hide become black. They are grey, reddish, and yellow, and so on, when they have dried up before the moisture in them has completely turned black. Where the process has been irregular, their colours are correspondingly variegated. So in all cases they correspond in colour to the hide and skin; for when men are reddish in colouring, their hair too is of a pale red; when they are black, it is black; and if white leprosy has broken out over some part of the body, the hair on that portion is also always white, like the marking on dappled animals. Thus all hair and feathering follows the colour of the skin, both regional hair[2] and hair which is spread[3] over the whole body. So, too, with hoofs, claws, beaks, and horns; in black animals they are black, in white animals they are white, and always because the nutriment percolates through the skin to the outer surface. A number of facts prove that this is the true cause. For example, the hair of all very young children is reddish owing to scanty nutriment; that this is so is clear from the fact that the hair of infants is always weak and thin and short at first; but as they grow older, the hair turns black, when the nutriment which flows into it

[1] 797b4. i.e. plants. [2] 797b 18. As in man.
[3] 797b 19. As in some animals.

settles[1] owing to its abundance. So, too, with the pubes and beard; when the hair is just beginning to grow on the pubic region and chin, it also is reddish at first, because the moisture in it, being scanty, quickly dries up, but as the nutriment is carried more and more to those regions the hair turns black. But the hair on the rest of the body remains reddish for a considerable time owing to lack of nutriment; for as long as it is growing, it keeps on turning
798a black like the pubes and the hair of the head. This is clear from the fact that hairs which have any length are generally blacker near the body and yellower towards the ends, because the moisture which reaches these parts of them is very scanty and soon dries up. This is the case with the hair of sheep and horses as well as with human hair;[2] the feathers, too, of black birds are in all cases darker near the body and lighter at the ends. The same is the case with the parts about the neck and, generally speaking, any part which receives scanty nutriment. This can be illustrated by the fact that before turning grey all hair changes colour and becomes reddish, because the nutriment again fails and dries up quickly; finally it becomes white, because the nutriment in it is completely matured before the moisture turns black. This can be illustrated from the parts of beasts of burden which are under the yoke; here the hair always turns white, for in those parts because, owing to the feebleness of the heat, they cannot draw up as much nourishment as the rest of the body, the moisture quickly dries up and turns white. So men tend especially to turn grey in the region of the temples, and generally speaking in any part which is weak and ailing. So, too, white is the colour to which more than any other a change tends to take place in instances of deviation from natural colour. For example, a hare has been known before now

[1] 797b 29. Reading *αὐταῖς* for *αὐτοῖς*.

[2] 798a 6. In Bekker's text the sentence *καὶ αἱ μὲν . . . ταχέως* has no verb, and there is no substantive for *αἱ* to agree with. The text is clearly disturbed; one MS., for example, puts the whole sentence at the end of the previous chapter. The simplest alteration, which also makes good sense, is to take the latter half of the sentence *διὰ τὸ . . . ταχέως* with the previous sentence, and for the first half to read: *καὶ αἱ μὲν τῶν προβάτων καὶ ἵππων καὶ ἀνθρώπων τρίχες οὕτως ἔχουσι· γίνονται δὲ κτλ.*

to be white—while black hares have also been seen[1]—and similarly white deer and bears have sometimes occurred; similarly white quails, partridges, and swallows. For all these creatures, when weak in their growth, come to maturity too soon owing to lack of nutriment, and so turn white. Similarly some infants at birth have white hair and eyelashes and eyebrows, a circumstance which normally occurs when old age is coming on and is then clearly due to weakness and lack of nutriment. Therefore in most classes 798b
of animals the white specimens are weaker than the black; for, owing to lack of nutriment, they over-mature before their growth is complete, and so turn white, just as does fruit when it is unhealthy; for fruit is still more apt to get over-mature through weakness. But when animals grow white and at the same time are far superior to the rest of their species, as is the case with horses and dogs,[2] the change from their natural colour to white is due to generous nutriment. For in such animals the moisture, not settling long, but being absorbed in the process of growth, does not turn black. Such animals are soft and well covered with flesh, because they are well nourished, and white hairs, therefore, never change colour. This is clear from the fact that black hairs, when the nutriment in them fails and matures too completely, turn reddish before they grow grey, but finally turn white. Yet some people hold that hair always turns black because its nutriment is burnt up by heat, just as blood and all other substances turn black under these conditions; but they are in error, for individuals of some species of animals are black from birth—dogs, for example, and goats, and oxen, and, generally speaking, those creatures whose skin and hair get nutriment from the very first—but they are less black as they get older. If their supposition were correct this ought not to be the case, but it would necessarily follow that the hair of all animals would turn

[1] 798a 26. Reading *καὶ μέλας δέ ποτε πέφηνε* as parenthetical. Prantl suggests *κάμηλος* for *μέλας*.

[2] 798b 7. Bekker and Prantl put a full stop after *κύνες*, in which case the sentence has no verb. The two sentences should run on together with only a comma after *κύνες*. This new class of animals will thus be contrasted with *τὰ πλεῖστα τῶν ζῴων*, l. 1.

black at their prime, when heat predominates in them, and that they would be more likely to be grey at first. For in the beginning the heat is always somewhat weaker than at the time when the hair begins to turn white. This is clear in the case of white animals also. Some of them are very white in colour at birth, those, namely, which at first have an abundance of nutriment, the moisture in which has not been prematurely dried up; but as they grow older their hair turns yellow, because less nutriment afterwards flows into it. Others are yellow at first and are 799a whitest at their prime. Similarly birds[1] change colour when the nutriment in them fails. That this is the case can be seen in the fact that in all these animals[2] it is the parts round the neck, and, generally speaking, any parts which are stinted when the nourishment is scanty, which turn yellow; for it is clear that, just as reddish colour turns black and *vice versa*, so white turns yellow and *vice versa*. This happens also in plants, some of which revert from a later stage in the process of maturation back again to an earlier stage. The best illustration of this is to be found in the pomegranate. At first its seeds are crimson, as are also its leaves, owing to the small amount of nourishment which matures completely; afterwards they turn to a herb-green, because a quantity of nutriment flows into them and the process of maturation is less able to predominate than before; but in the end the nutriment does mature and the colour reverts to crimson.

To sum the matter up, in hair and feathers of every kind, changes always occur either—as has already been remarked—when the nutriment in them fails, or when, on the contrary, it is too abundant. Therefore the age at which the hair is at its whitest or blackest varies in different cases; for even ravens' feathers turn yellow 799b in the end, when the nutriment in them fails. But hair is never crimson or violet or green or any other colour of that kind, because all such colours arise only by mixture with the rays of the sun, and further because in all hairs which

[1] 799a 1. Keeping MS. ὀρνίθων but reading μεταβάλλει.
[2] 799a 3. Reading πάντα γὰρ ταῦτα.

contain moisture the changes take place beneath the skin, and so they admit of no admixture. This is clear from the fact that no feathers have their distinctive colouring at first, but practically all gaily coloured birds start by being black—the peacock, for example, and the dove and the swallow; it is only later that they assume all their varied colours, the process of maturation taking place outside their bodies in their feathers and combs and wattles.[1] Thus in birds, as in plants, the maturation of the colours takes place outside the body. So, too, the other forms of animal life—aquatic creatures, reptiles, and shell-fish—have all sorts and manners of colouring, because in them too the process of maturation is violent.

From what has been set forth in this treatise one may best understand the scientific theory of colours.

[1] 799^b 14. Bekker reads *ἔν τε τοῖς πτερώμασι καὶ τοῖς καλαίοις*. Of Bekker's MSS. E and M read *κάλοις*, X *καυλοῖς* (quills), P *λόφοις*. The Munich MS. collated by Prantl reads *πτερώμασι καὶ τοῖς λόφοις καὶ τοῖς καλέοις*, which is here adopted. The mention of *λόφοι* and *κάλεα* (for the form cf. Aelian, *N. A.* v. 5, xi. 25, xv. 1) seems justified by 797^b 19.

DE AUDIBILIBUS

BY

T. LOVEDAY AND E. S. FORSTER

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PREFACE

This tract appears to be a fragment of a larger work. It is certainly not Aristotle's, and has been ascribed with some likelihood to Strato. It has never been separately edited. Prantl's text in the Teubner edition (1881) has been used.

Mr. W. D. Ross's advice has again been invaluable to us.

T. L.
E. S. F.

DE AUDIBILIBUS

All sounds, whether articulate or inarticulate, are 800a produced by the meeting of bodies with other bodies or of the air with bodies, not because the air assumes certain shapes, as some people think, but because it is set in motion in the way in which, in other cases, bodies are moved, whether by contraction or expansion or compression, or again when it clashes together by an impact from the breath or from the strings of musical instruments. For, when the nearest portion of it is struck by the breath which comes into contact with it, the air is at once driven forcibly on, thrusting forward in like manner the adjoining air, so that the sound travels unaltered in quality as far as the disturbance of the air manages to reach. For, though the disturbance originates at a particular point, yet its force is dispersed over an extending area, like breezes which blow from rivers or from the land. Sounds which happen for any reason to have been stifled where they arise, are dim and misty; but, if they are clear, they travel far and fill all the space around them.

We all breathe in the same air, but the breath and the sounds which we emit differ owing to structural variations of the organs at our disposal, through which the breath must travel in its passage from within—namely, the windpipe, the lungs, and the mouth. Now the impact of the breath upon the air and the shapes assumed by the mouth make most difference to the voice. This is clearly the case; for indeed all the differences in the kinds of sounds which are produced proceed from this cause, and we find the same people imitating the neighing of horses, the croaking of frogs, the song of the nightingale, the cries of cranes, and practically every other living creature, by means of the same breath and windpipe, merely by expelling the air from the mouth in different ways. Many birds also imitate by these means the cries of other birds which they hear.

As to the lungs, when they are small and inexpansive and hard, they cannot admit the air nor expel it again in large quantities, nor is the impact of the breath strong and vigorous. For, because they are hard and inexpansive and constricted, they do not admit of dilatation to any great extent, nor again can they force out the breath by contracting after wide distension; just as we ourselves cannot
800b produce any effect with bellows, when they have become hard and cannot easily be dilated and closed. For what gives strength to the impact of the breath is that the lungs after wide distension contract and violently force out the air. This can be illustrated from the other parts of the body, none of which can strike a blow with any effect at a very close distance. It is impossible with either the leg or the hand to smite the object of your blow with any force or to hurl it far, unless you allow the limb a considerable distance in which to strike the blow. If you fail to do so, the blow is hard owing to the energy exerted, but it cannot force its object far. Under similar circumstances stone-throwing engines cannot shoot far, nor a sling, nor a bow, if it is stiff and will not bend, and the string cannot be drawn back far. But if the lung is large and soft and flexible, it can admit the air and expel it again in large quantities, regulating it at will, thanks to its softness and the ease with which it can contract.

As for the windpipe, when it is long and narrow, it is only with difficulty that the voice is emitted, and considerable force is required owing to the distance that the breath has to travel. This is clear from the fact that creatures which have long necks force out their cries—geese, for example, and cranes and domestic fowls. A better illustration may be taken from the oboe; every one, for instance, finds a difficulty in filling an oboe of the kind called the 'silkworm',[1] and considerable exertion is required owing to the amount of space to be filled. Further-

[1] 800b 25. For this instrument cf. Pollux, *Onomasticon*, iv. 10, and Chappell, *History of Ancient Music*, p. 268.

more, owing to narrowness of the passage, the breath is compressed within, and on escaping immediately expands and disperses, like streams when they pass through narrow straits; so that the voice is not sustained and does not carry far. Moreover, in such cases the breath must necessarily be hard to regulate and not easily controlled. On the other hand, when the windpipe is of considerable width, the breath can pass out easily, but, whilst travelling within, it becomes dispersed owing to the abundance of space, and the voice becomes hollow and lacks solidity; furthermore, creatures which have wide windpipes cannot articulate[1] 801a
clearly with their breath because the windpipe does not hold firmly together. Creatures in whom the windpipe is irregular and has not the same width throughout must suffer from difficulties of every kind; for their breath must be under irregular control, and must be compressed in one part and dispersed again in another part. If the windpipe is short, it necessitates a quick expulsion of the breath, and the impact on the air is more violent; in such cases the voice is more piercing owing to the quick passage of the breath.

Not only structural variations in the organs of speech make a difference to the voice, but also their condition. When the lungs and the windpipe are full of moisture, the breath is impeded and does not pass out continuously, because it is interrupted and becomes thick and moist and difficult to move, as happens in the case of a catarrh and in drunkenness. If the breath be absolutely dry, the voice becomes rather hard and dispersed; for moisture, when it is slight, holds the air together and causes, as it were, a unity in the voice. Such, then, are the differences in the voice caused by structural variations in the organs of speech and the varying condition of the organs.

Now though we localize sounds where they severally originate, yet in every case we actually hear them only when they strike upon the ear; for the air struck by the impact of the breath is borne along for a certain distance in a mass, and then gradually becomes dispersed, and we

[1] 801a 1. Reading *διαρθροῦσθαι* for *διαιρεῖσθαι*.

hereby distinguish all sounds as near or distant. This can be illustrated by the fact that if a man takes a pot[1] or a pipe or a trumpet and holds it up to another man's ear and speaks through it, all the sounds which he utters seem quite close to the ear, because the air passing along the tube is not dispersed and the sound is kept uniform by the instrument which encloses it. Just as in a picture, if an artist represents two objects in colour, one as though it were at a distance and the other as though it were close at hand, the former object appears to us to be sunk into the background of the picture and the latter to stand out in the foreground, though they are really in the same plane; so, too, in the case of sounds, whether articulate or inarticulate, if one sound is already dissolved before it strikes the ear, whilst another still retains its continuity, though both reach the same spot, the former seems distant from the ear and the latter quite near to it, because the one
801b resembles a sound coming from afar, the other a sound[2] close at hand.

Voices are distinct in proportion to the accuracy of the sounds uttered; for it is impossible for the voice to be distinct if the sounds are not perfectly articulated, just as the sealings of signet-rings cannot be distinct unless they are accurately impressed. For this reason children cannot speak distinctly, nor drunken persons, nor old people, nor those who naturally lisp, nor, speaking generally, those whose tongues and mouths have any defect of movement. For as in instrumental music the sound produced by the combination of brass instruments and horns is less distinct, so too, in the case of speech, great indistinctness is caused by the escape of breath from the mouth if the sounds are irregularly formed. They not only present themselves indistinctly, but they also impede the carefully articulated sounds, because the movement to which they give rise, and which affects the ear, is irregular. Therefore, when we hear one person speaking, we understand better than when we hear a number of persons saying the same thing

[1] 801a 28. Reading with the MSS. *κέραμον*.
[2] 801b 1. Reading *τὴν δὲ ⟨τῇ⟩ πλησίον*.

at the same time. The same is the case with stringed instruments; and we hear still less well when the oboe and lyre are played at the same time, because the sounds confuse one another. This is particularly evident when they are played in harmony, the result being that the two sounds produced drown one another. The conditions under which sounds become distinct[1] have now been stated.

Clearness in sound resembles clearness in colour. Those colours which most affect the eye are most clearly seen; in like manner we must suppose that those sounds are most clearly heard which are most able to affect the hearing, when they strike upon it, in other words sounds which are distinct and solid and pure, and have most power of penetration; for indeed it is a general law of sense-perceptions that the most distinct impressions are produced by the strongest, solidest, and purest stimuli. This is borne out by the fact that all sounds finally become dim as the air which carries them becomes dispersed. The point can also be illustrated from the oboe; the sounds produced by oboes which have sloping reeds in their mouthpieces[2] are softer, but not so clear; for the breath being forced down passes immediately into a wide space and is not continuously and consistently sustained, but becomes dispersed. But when the reeds are closely constructed,[3] the sound produced is harder and clearer, the more one presses them against the lips, because the breath is thus emitted with more violence. Such, then, are the conditions of clearness in the voice. 802a So voices which are called 'grey'[4] are generally considered no worse than those which are called 'white'.[5] For voices which are rather harsh and slightly confused and have not any very marked clearness are the fitting accompaniment of outbreaks of passion and of advancing years, and at the same time, owing to their intensity,

[1] 801b 21. Reading σαφεῖς for ἀσαφεῖς. The latter, however, is not impossible.

[2] 801b 33. Reading ζευγῶν for δευτέρων, cf. 802b 22. For the technical terms connected with the αὐλός see A. A. Howard, *The Αὐλός or Tibia*, Harvard Studies in Classical Philology, vol. iv (1893).

[3] 801b 37. Reading συγκροτητέραις (on the analogy of κροτητός) for the MS. reading συγκροτέραις, for which Bekker reads σκληροτέραις.

[4] 802a 2. i.e. harsh.

[5] 802a 2. i.e. clear.

they are less under control; for what is produced by violent exertion is not easily regulated, for it is difficult to increase or decrease the strength of the sound at will.

In the case of oboes and other instruments of the same class, the sounds produced are clear when the breath emitted from them is concentrated and intense. For the impacts on the external air must be of this kind, and it is in this way that they will best travel to the ear in a solid mass. Similarly, in the case of odours and light and the various forms of heat, the weaker they are, the less definite is the impression which they convey to the sense-perception, just as juices are weaker when mixed with water or with other juices. Any second ingredient which makes itself felt obscures the power of the original object.

In contrast to all other musical instruments the notes produced by horns, if they strike the air in a solid and continuous mass, are indistinct. Therefore the horn which you choose ought to be one the nature of whose growth is regular and smooth, and which does not shoot up quickly. For such horns as shoot up quickly must necessarily be too soft and spongy, so that the notes are dispersed and do not pass out in a solid mass, nor do they produce a consistent sound owing to the softness of the horn and the sponginess caused by the pores. On the other hand, the horn must not be of too slowly growing a kind, nor must it be of a thick, hard consistency and lacking in resonance;[1] for, if the sound in its passage strikes against anything, it is arrested at that point and ceases to advance on its outward course, so that the notes which proceed from such horns are dull and irregular. That the direction taken by sound follows a straight line is clear from the way in which carpenters test beams and large timber in general. For when they strike one end, the sound passes along continuously to the other end unless the wood has some flaw in it; if it has a flaw, the sound travels along up to that point and there ceases and is dispersed. It passes round the knots in the wood and cannot continue in a straight course through them. The point can also be illustrated from what

[1] 802[a] 26. The meaning of *δύσφορον* is very doubtful.

happens in bronze-working when they are filing down the loosely hanging folds of drapery or the wings of statues; the cracks close up, so that the metal gives out a rasping sound and causes a considerable noise; but the sound immediately ceases if you tie a band round the folds; for the vibration continues till it strikes the soft material and is there checked.

The baking of horns contributes greatly to the excellence 802b
of their tone; for, when they are well baked, they produce a sound very like that of pottery, owing to the hardness caused by the heat; whilst, if they are not sufficiently baked, the sound which they make is too gentle owing to the softness of the horn, and they cannot produce such well-defined notes. Men, therefore, choose the ages of their horns; the horns of old animals are dry and callous and porous, while those of young animals are quite soft and contain a considerable amount of moisture. As we have said, a horn should be dry, of uniform thickness, with straight pores and a smooth surface; for if it be so, the notes which pass through it will be full and smooth and even, and the impacts which they make upon the outer air will have the same qualities. For those strings too are best which are smoothest and most even all along, and show[1] the same workmanship throughout, and in which the joining of the gut is not visible; for then the impacts which they make upon the air are most even.

The reeds of oboes, too, must be solid and smooth and even, so that the breath may pass through smoothly and evenly, without being dispersed. Therefore mouthpieces which have been well steeped and soaked in grease give a pleasant sound, while those which are dry produce less agreeable notes. For the air passes softly and evenly through a moist and smooth instrument. This is clear from the fact that the breath itself, when it contains some moisture, is less likely to strike against the mouthpiece and become dispersed; while dry breath is inclined to catch in the oboe, and the impact which it causes is too

[1] 802b 16. Reading with Wallis ἔχουσαι for ἔχουσι.

hard owing to the force necessary to expel it. Differences, then, in sound arise from the above causes.

Hard voices are those which strike forcibly upon the hearing; for which reason they are particularly unpleasing —those, that is to say, which are difficult to start, but which when once started travel with added force—for any quickly yielding body which comes in the way fails to abide the impact and quickly springs aside. To take an illustration of this; heavy missiles travel along with force, as do streams when they pass through narrow channels, for they acquire very considerable force in the actual straits, because they cannot yield to restraint all in a moment, but are driven violently along. The same thing happens in the case of articulate and inarticulate sounds. For clearly all forceful sounds are hard; as, for instance, those caused by the forcible opening of boxes and turning of hinges, and those made by bronze and iron. For the
803a sound made on the anvil is hard[1] when the iron that is being forged is chilled and has become hard. So, too, is the noise from the file, when they are filing iron implements and making teeth in saws. The most violent claps of thunder, too, produce very hard sounds, and those showers which from their violence we call 'tearing' showers.

It is quickness of breathing which makes the voice shrill, force which makes it hard. So it happens that the same individuals have not only sometimes a shriller and at other times a deeper voice, but also at times a harder and at times a softer voice. Yet some people hold that it is owing to the hardness of the windpipe that the voice becomes hard. In this they are wrong; for, though this may be quite a slight contributing cause, the real reason is the force of the impact caused by the breath from the lungs. For as some men's bodies are moist and soft, while those of others are hard and closely knit, so do their lungs show variety. Therefore in some cases the breath which comes forth is soft, in others it is hard and violent; for it is easy to see at a glance that the windpipe by itself exercises

[1] 803a 1. Omitting *καὶ μαλακός*, which is due to *σκληροτέραν καὶ μαλακωτέραν*, l. 8 below.

but little influence. For no windpipe is of the hard consistency of an oboe; yet for all that, by passing the breath through the former and through the latter, some people produce soft and others hard tones on the oboe. This is clear from the direct perception; for, if by using greater force one increases the strength of the breathing, the voice immediately becomes harder as a result of the force applied, even if it be naturally a somewhat soft voice. So, too, in the case of the trumpet; when they are revelling,[1] men relax the pressure of breath in the trumpet in order to make the sound as soft as possible. The point can also be illustrated from other classes of musical instruments;[2] as has been stated, the sounds produced by tightly stretched strings are hard, as are the notes of horns which have been well baked. If one touches the strings violently instead of softly with the hand, they necessarily respond with more violent sounds. The notes produced by less tightly stretched strings and unbaked horns are softer, as are those produced by the longer musical instruments; for the impacts upon the air are both slower and softer owing to the distance that the sound has to travel, whereas in the shorter instruments they are harder owing to the tension of the strings. That this is so is shown by the fact that the sounds which the instrument itself gives forth are harder when one does not strike the string in the middle, because there is more strain upon the parts of the strings near the crossbar and near the pegs. The notes produced by instruments made of fennel-wood are softer; for the sounds striking on a soft material do not rebound with such 803b
violence.

Voices are rough when the impact of all the breath upon the air is not single and simultaneous but divided and broken. For each portion of the air striking separately upon the hearing—as if each were moved by a different impact—the sense-impression is broken, so that one vocal utterance fails to produce any sound, while another strikes

[1] 803a 25. Or perhaps, 'when they are accompanying a hymn of victory.'

[2] 803a 27. Reading ἐπὶ τῶν ⟨ἄλλων⟩ ὀργάνων.

with great violence upon the ear, and the contact with the hearing is not evenly sustained; just as when a rough object touches the skin. This can be best illustrated from the file; for, when a file is being used, the air is set in motion simultaneously at a number of separate minute points, and so the sounds passing from these points to strike the ear seem rough, and especially so when the file is scraped against a hard substance. One may compare the sense of touch; hard, rough objects produce stronger[1] tactual impressions. The matter can also be illustrated from the pouring of liquids, for the sound made by olive-oil is less noticeable than that made by any other liquid, owing to the unbroken continuity of the parts which compose it.

Voices are thin, when the breath that is emitted is small in quantity. Children's voices, therefore, are thin, and those of women and eunuchs, and in like manner those of persons who are enfeebled by disease or over-exertion or want of nourishment; for owing to their weakness they cannot expel the breath in large quantities. The same thing may be seen in the case of stringed instruments; the sounds produced from thin strings are thin and narrow and 'fine as hairs', because the impacts upon the air have only a narrow surface of origin. For the sounds that are produced and strike on the ear are of the same quality as the source of movement which gives rise to the impacts; for example, they are spongy or solid, soft or hard, thin or full. For one portion of the air striking upon another portion of the air preserves the quality of the sound, as is the case also in respect of shrillness and depth; for the quick impulsions of the air caused by the impact, quickly succeeding one another, preserve the quality of the voice, as it was in its first origin. Now the impacts upon the air from strings are many and are distinct from one another, but because, owing to the shortness of the intermittence, the ear cannot appreciate the intervals, the sound appears to us to be united and continuous. The same thing is the case with colours; for separate coloured objects appear to join, when they are moved rapidly before our eyes. The

[1] 803b 14. Reading *βιαιοτέραν* for *βιαιότερον*.

same thing happens, too, when two notes form a concord; for owing to the fact that the two notes overlap and include one another and cease at the same moment, the intermediate 804[a] constituent sounds escape our notice. For in all concords more frequent impacts upon the air are caused by the shriller note, owing to the quickness of its movement; the result is that the last note strikes upon our hearing simultaneously with an earlier sound produced by the slower impact. Thus, because, as has been said, the ear cannot perceive all the constituent sounds, we seem to hear both notes together and continuously.

Thick sounds, on the contrary, are produced when the breath is emitted in great quantity and all together. Therefore the voices of men are inclined to be thick, and the notes of the so-called 'perfect' oboes, especially when the latter are well filled with air. This is clear from the fact that if you compress the mouthpiece the sound tends to become shrill and thin, as also if one draws the 'speaker' downwards;[1] but if one stops up the exits, the volume of the sound becomes far greater owing to the amount of breath collected in the instrument, like the notes produced from thicker strings. The sounds uttered by those whose voices are breaking and persons suffering from sore-throats, and after vomiting, are thick owing to the roughness of the windpipe and the fact that the voice does not escape, but striking upon it is pent up and acquires volume; and above all, owing to the moist condition of the body.

Piping voices are those which are thin and concentrated, such as those of grasshoppers and locusts and the nightingale's song, and, generally speaking, cries which are thin, and are not followed by a second and different sound. For this piping quality does not depend on volume of sound

[1] 804[a] 14. As this line is punctuated by the Teubner Text and by Bekker, no sense can be obtained. It should be punctuated as follows: *λεπτοτέρα, κἂν κατασπάσῃ τις τὰς σύριγγας· ἂν δὲ ἐπιλάβῃ κτλ.* Here *σύριγγες* are apparently the same as *γλῶτται*: A. A. Howard, op. cit., quotes Aristoxenus p. 28 and Plutarch, p. 1096[a], and suggests that the reference may be to a small hole covered with a sliding band and known as 'the speaker' in a modern clarinet. Gevaert, *Histoire et Théorie de la Musique de l'Antiquité*, ii. 643, takes the *σύριγξ* to be a musical instrument which could be lengthened or shortened. The whole subject is very obscure.

nor on the tones being without tension and deep, nor yet upon the close sequence of the sounds, but rather upon shrillness and thinness and accuracy. Therefore it is the instruments which are lightly constructed and tightly stretched, and those which have no horn-work about them, that produce piping notes. The sound of running water, and generally speaking, any sound which, whatever its cause, keeps up an unbroken continuity, preserve the accuracy of their tone.

Cracked voices which suddenly give way are those which travel along in a solid mass for a certain distance and then become dispersed. The best illustration may be taken from an earthenware vessel; every such vessel when broken as the result of a blow gives forth a cracked sound, for the course of the sound is broken at the point at which the blow was struck, so that the sounds which it gives forth no longer form a solid mass. The same thing happens in the case of broken horns and badly strung strings; in all such cases the sound travels in a solid mass up to a certain point and 804b is then dispersed, wherever the medium which supports it is not continuous, so that the impact upon the air is not single but dispersed, and the sound produced seems cracked. Cracked voices closely resemble harsh voices, except that in the latter case the sounds are themselves dispersed into small portions, while cracked voices, for the most part, form a solid mass at first and afterwards become split up into a number of parts.

Aspirated sounds are formed when we emit the breath from within immediately together with the sounds; smooth sounds, on the contrary, are those which are formed without the emission of the breath.

Voices become broken when they have no longer strength enough to expel the air with an impact, but the region about the lungs collapses after distension. For just as the legs[1] and shoulders eventually collapse when they are in a strained position,[2] so too the region about the lungs. The breath, when it does come forth, comes forth lightly,

[1] 804b 14. Reading with Wallis *σκέλη* for *σκεύη*.
[2] 804b 15. Reading *συντόνους ὄντας* for *συντόνως*.

because the impact which it produces is not forcible enough; at the same time, owing to the fact that the windpipe has become exceedingly rough, the breath cannot pass out in a solid mass, but is dispersed, and so[1] the sounds which it produces are broken. Some people hold that it is owing to the adhesive condition of the lungs that the breath cannot pass out and abroad; but they are wrong, for what really happens is that they make a sound but cannot speak out, because the impact upon the air does not take place with sufficient energy, but they only make a sound such as the breath would make when forced merely from the throat.

When people stammer, it is due not to an affection of the veins or windpipe, but to the movement of the tongue; for they find a difficulty in changing the position of the tongue when they have to utter a second sound. They therefore keep on repeating the same word, for they cannot utter the next word; but the movements of articulation continue and the lungs go on working with an impetus in the same direction as before, owing to the quantity and force of the breath. For just as when one is running fast it is difficult to divert the whole body from its impetus in one direction to some other movement, so likewise is it with the individual parts of the body. So people who stammer are often unable to say the next word, but can easily say the next but one, when they make a fresh start. This explanation of stammering is supported by the fact that people often stammer when angry, because then they force out their breath.

[1] 804b 20. Reading ὥστ' for ὡς.

PHYSIOGNOMONICA

BY

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PREFACE

This work, as we have it, is evidently a compilation of two treatises, the second beginning with Chapter IV. Neither is Aristotle's: both may be Peripatetic. Prantl's text (Teubner, 1881) has been used, but a great many emendations have been taken from Förster's text and notes in his *Scriptores Physiognomonici* (1893), vol. i. On Förster's excellent work we have chiefly relied; J. B. Porta's *De humana physiognomonia* (1650) has also proved very useful. We have, as before, to thank Mr. W. D. Ross for his kind advice and suggestions.

After some hesitation we decided to use the less clumsy forms 'Physiognomy', 'physiognomic', in place of the more accurate 'Physiognomony', 'physiognomonic'.

T. L.
E. S. F.

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PHYSIOGNOMONICA

I MENTAL character is not independent of and unaffected by bodily processes, but is conditioned by the state of the body; and contrariwise the body is sympathetically influenced by affections of the soul.[1] The former of these propositions is well exemplified by drunkenness and sickness, where altered bodily conditions produce obvious mental modifications, and the second by the emotions of love and fear, and by states of pleasure and pain.[2] But still better instances of the fundamental connexion of body and soul and their very extensive interaction may be found in the normal products of nature.[3] There never was an animal with the form of one kind and the mental character of another: the soul and body appropriate to the same kind always go together, and this shows that a specific body involves a specific mental character. Moreover, experts on the lower animals are always able to judge of character by bodily form: it is thus that a horseman chooses his horse or a sportsman his dogs. Now, supposing all this to be true (and it always is true), physiognomy must be practicable. 805^{a}

Three methods have been essayed in the past, each having had its special adherents.

1. The first method took as the basis for physiognomic inferences the various genera of animals, positing for each genus a peculiar animal form, and consequently upon this a peculiar mental character, and then assuming that if a man resembles such and such a genus in form he will resemble it also in soul.[4]

[1] 805^{a} 2, 3. Read κινήσεων, τοῦτο δῆλον (as in Stobaeus, *Anthol.* i. 47^{b}).

[2] 805^{a} 7. Place τε after λύπας, as Förster suggests.

[3] 805^{a} 8. i.e. in animals.

[4] 805^{a} 21, 22. Read with Wachsmuth *οἱ μὲν γὰρ ἐκ τῶν γενῶν τῶν ζῴων φυσιογνωμονοῦσι, τιθέμενοι καθ' ἕκαστον γένος εἶδός τι ζῴου καὶ διάνοιαν οἵα ἕπεται τῷ τοιούτῳ σώματι, εἶτα τὸν ὅμοιον τούτῳ τὸ σῶμα* [or keep *τῷ σώματι σῶμα*] *ἔχοντα καὶ τὴν ψυχὴν ὁμοίαν ὑπελάμβανον.*

2. Those who adopted the second method proceeded in the same way, except that they did not draw their inferences from all kinds of animals but confined themselves to human beings: they distinguished various races of men (e.g. Egyptian, Thracian, Scythian) by differences of appearance and of character, and drew their signs of character from these races just as others did from animal genera.

3. The third method took as its basis the characteristic facial expressions which are observed to accompany different conditions of mind, such as anger, fear, erotic excitement, and all the other passions.

All these methods are possible, and others as well: the 805b selection of signs may be made in diverse ways. The last-mentioned method by itself, however, is defective in more than one respect. For one thing, the same facial expression may belong to different characters: the brave and the impudent, for example, look alike, though their characters are far asunder. Besides, a man may at times wear an expression which is not normally his: for instance, a morose person will now and again spend an enjoyable day and assume a cheerful countenance, whilst a naturally cheerful man, if he be distressed, will change his expression accordingly. And, thirdly, the number of inferences that can be drawn from facial expression alone is small.

As to arguments from beasts, the selection of signs is made on wrong principles. Suppose you have passed in review one by one the forms of all the different kinds of animals, you still have no right to assert that a man who resembles a given kind in body will resemble it in soul also. In the first place, speaking broadly, you will never find this complete likeness, but only a resemblance.[1] Moreover, very few signs are peculiar to individual genera; most of them are common to more than one kind, and of what use is resemblance in a common attribute? A man will resemble a lion, let us say, neither more nor less than a deer. (For we have a right to suppose that common signs indicate common mental characters and peculiar

[1] 805^b 15. μέν τι should probably be omitted with I^a, but Hayduck's ἕν τι is attractive.

signs peculiar characters). Thus the physiognomist will not get any clear evidence from common signs.[1] But is he any better off if he takes every genus by itself and selects signs that are peculiar to each? Surely not, for he cannot tell what they are signs of. They ought to be signs of peculiar characteristics, but we have no right to assume that there are any *mental* characteristics peculiar to the different kinds of animals that we examine in physiognomy. Courage is not confined to the lion, but is found in many other creatures; nor timidity to the hare, but it shares this quality with numberless other creatures. Thus it is equally fruitless to select the common and the peculiar features, and we must abandon the attempt to proceed by an examination of every kind of animal singly. Rather, we ought to select our signs from all animals that have some mental affection in common.[2] For instance, when investigating the external marks of courage, we ought to collect all brave animals, and then to inquire what sort of affections are natural to all of them but absent in all other animals. For if we were to select this or that as the signs of courage 806a
in the animals chosen in such a way as not to exclude the possibility of the presence in all these animals of some other mental affection,[3] we should not be able to tell whether our selected marks were really signs of courage or of this other character. Two conditions must be fulfilled, therefore:—the animals from which we choose our signs must be as numerous as possible, and they must not have any mental affection in common except that one of which we are investigating the signs.

Permanent bodily signs will indicate permanent mental qualities, but what about those that come and go? How can they be true signs if the mental character does not also come and go?[4] No doubt if you took a transitory

[1] 805b 21. Read with Förster *διασαφήσειε* on the evidence of the Latin version by Barth. Messanius.

[2] 805b 29. The Latin version of Barth. Mess. supports *ἁπάντων* in place of *ἀνθρώπων*. Otherwise *ἀνομοίων* would seem more likely to have given rise to the error.

[3] 806a 1–3. Inserting *ὥστε* before *μή*. Wachsmuth proposed to omit *ταῦτά ἐστι τὰ σημεῖα ἀνδρείας*.

[4] 806a 9. Omitting *μή* with Hayduck.

sign to be permanent, it might be true once in a way, but still it would be worthless because it would not be a constant concomitant of a particular state of soul.[1]

Then again there are affections of soul whose occurrence produces no change in the bodily marks on which the physiognomist relies, and they will not provide his art with recognizable signs.[2] Thus as regards opinions or scientific knowledge, you cannot recognize a doctor or a musician, for the fact of having acquired a piece of knowledge will not have produced any alteration in the bodily signs on which physiognomy relies.

We must now determine the special province of physio- 2
gnomy (for the range of its application is limited), and the sources from which its various kinds of data are drawn, and then we may proceed to a detailed exposition of the more convincing among its conclusions.

Physiognomy has for its province, as the name implies, all natural affections of mental content, and also such acquired affections as on their occurrence modify the external signs which physiognomists interpret.[3] I will explain later what kinds of acquired characters are meant, but now I will give a list—a complete list—of the sources from which physiognomic signs are drawn. They are these: movements, gestures of the body, colour, characteristic facial expression, the growth of the hair, the smoothness of the skin, the voice, condition of the flesh, the parts of the body, and the build of the body as a whole. Such is the list that physiognomists always give of the sources in which they find their signs. Had this list been obscure or insignificant,[4] there would have been no use in my going any further; but, as things are, it may be worth while
806b to give a more detailed description of the more convincing[5] of the inferences that they draw from their material, and

[1] 806a 12. F. reads *παθήματι* for *πράγματι*.

[2] 806a 15. Or, accepting F.'s suggested *γνωριστά*, 'they will not be recognizable by his art.'

[3] 806a 25. The text seems to be corrupt. The error may lie in *μεθίστησι*. F. suggests *τὰ σημεῖα τῶν κτλ*.

[4] 806a 35. F. reads *εὐσαφὴς ἢ μὴ ἄσημος*.

806a 37. Read *ἐπιφανέστερα τῶν*. F.

to state[1] what their various signs are and where they are supposed to be found, so far as I have not already done so.

A brilliant *complexion* indicates a hot sanguine temper, whilst a pale pink complexion signifies naturally good parts, when it occurs on a smooth skin.

Soft *hair* indicates cowardice, and coarse hair courage. This inference is based on observation of the whole animal kingdom. The most timid of animals are deer, hares, and sheep, and they have the softest coats; whilst the lion and wild-boar are bravest and have the coarsest coats. Precisely the same holds good of birds, for it is the rule that birds with coarse plumage are brave and those with soft plumage timid, particular instances being the cock and the quail. And again, among the different races of mankind the same combination of qualities may be observed, the inhabitants of the north being brave and coarse-haired, whilst southern peoples are cowardly and have soft hair. A thick growth of hair about the belly signifies loquacity, on the evidence of the whole tribe of birds, for the one is a bodily and the other a mental property peculiar to birds.[2]

When the *flesh* is hard and constitutionally firm, it indicates dullness of sense; when smooth, it indicates naturally good parts combined with instability of character, except when smooth flesh goes with a strong frame and powerful extremities.

Lethargic *movements* are a sign of a soft character, rapid movements of a fervid temper.

As to the *voice*, when deep and full it is a sign of courage; when high-pitched and languid, of cowardice.

Gesture and the varieties of *facial expression* are interpreted by their affinity to different emotions: if, for instance, when disagreeably affected, a man takes on the look which normally characterizes an angry person, irascibility is signified.[3]

[1] 806b 1. Omitting *τε* with F.

[2] These qualities are *ἴδια* of birds in the sense that they do not occur in the rest of the lower animals; but they may occur in men, for otherwise no physiognomic conclusions could be drawn from them.

[3] 806b 30–31. Reading *ὅταν γὰρ πάσχῃ τι, εἰ τοιοῦτόν τι γίνεται οἷον ἔχει ὅταν τις ὀργίζηται, ὀργίλου τὸ σημεῖον. τοῦ δ' αὐτοῦ γένους τὸ ἄρρεν κτλ.*

Males are bigger and stronger than females of the same kind, and their extremities are stronger and sleeker and firmer and capable of more perfect performance of all functions. But inferences drawn from the parts of the body are less secure than those based on facial expression of character[1] and movements and gesture. In general it
807a is silly to rely on a single sign: you will have more reason for confidence in your conclusions when you find several signs all pointing one way.

Here I may mention a possible method of physiognomy which has never yet been tried. Suppose, e.g., that irascibility and morose sulkiness[2] necessarily involve an envious disposition, and that the physiognomist could, without any bodily signs of the last character, deduce its presence from the presence of the other characters, we should then have a method peculiarly appropriate to masters of philosophy, since it is, we suppose, the peculiar mark of philosophy, when certain premises are given, to know the necessary conclusion.[3] But this method which considers the interrelations of mental affections and that which proceeds by empirical observation of animals sometimes arrive at contrary conclusions.[4] Take the voice, for example. By the former method you might feel bound[5] to connect a shrill voice with a fierce temper, because in vexation and anger one's voice tends to become loud and shrill, whilst placid people speak in tones at once languid and deep. But as against this, if you observe beasts, you find that a deep voice goes with courage and a shrill voice with timidity, as witness on the one hand the roar of lion and bull, the hound's bay, and the deep-noted crow of high-spirited cocks, and on the other, the high-pitched tones of deer and hares.

[1] 806b 36. Omitting *ἐν τοῖς* with three MSS. Cf. 805a 28.

[2] 807a 5. Reading *πικρόν* with Sylburg.

[3] 807a 10. Reading *τὸ ἀναγκαῖον εἰδέναι.* Schneider reads *ὅπερ ἐστὶν ἀναγκαῖον εἰδέναι.*

[4] 807a 11, 12. In this very corrupt passage F. reads *ἔστιν ὅτε ἐναντιοῦται τῷ κατὰ τὰ πάθη φυσιογνωμονεῖν τὸ κατὰ τὰ ζῷα. ἔστι δ' ὅτε* seems necessary to avoid undue abruptness. The abruptness of the next sentence *περὶ φωνῆς* is suspicious. The sense is *κατὰ τὰ ζῷα, οἷον περὶ φωνῆς κατὰ μὲν κτλ.*

[5] 807a 14. Read with La *δεῖν* in place of *δυεῖν ἕνεκεν.*

Yet perhaps even in these cases it is better not to connect courage and cowardice with the pitch of the voice, but rather with its intensity, so that[1] it is strength of voice that marks the brave and a languid and feeble voice the coward. It is safest, however, to refrain from all positive assertion when you find that your signs are inconsistent and contrary to one another in detail, unless they belong to classes, some of which you have determined to be more trustworthy than others. Above all it is best to base your arguments upon assertions about species and not about entire genera, for the species more nearly resembles the individual, and it is with individuals that physiognomy is concerned; for in physiognomy we try to infer from bodily signs the character of this or that particular person, and not the characters of the whole human race.

3 Signs of *Courage* are—coarse hair; an upright carriage of the body; size and strength of bones, sides and extremities; the belly broad and flat; shoulder-blades broad and set well apart, neither too closely nor too loosely knit; a sturdy neck, not very fleshy; a chest well covered with flesh and broad; flat hips; the thickness of the calf low 807b
down the leg;[2] gleaming eyes, neither wide and staring nor yet mere slits, and not glistening; the body of a brilliant hue;[3] a forehead straight and lean, not large, and neither quite smooth nor yet a mass of wrinkles. Signs of *Cowardice* are—a small growth of soft hair; the figure stooping[4] and lacking in quickness; the thickness of the calf high up the leg; a sallow complexion; weak blinking eyes; weak extremities; little legs, and hands long and delicate; loins small and weak; a rigid gesture of the body;[5] with undecided, deprecating, scared movements, and a shifty downcast look.

Good natural parts are indicated by rather moist and

[1] 807a 23. F. thinks that there is a lacuna between *ἐν τῷ* and *τὴν μὲν ἐρρωμένην*, and suggests that the last of the missing words may be *ὥστε φωνήν*. But it is more likely that there is an anacoluthon.

[2] 807b 1. Read with Schneider *κατεσπασμέναι*.

[3] 807b 2, 3. Read *συμμύον, αὐχμηρότερον· τὸ . . . σώματος ὀξύ· μέτωπον εὐθύ*, &c.

[4] 807b 5. Read *τῷ σώματι συγκεκαθεικώς*.

[5] 807b 10. Read *τὸ σῶμα σύντονον, ἐν ταῖς κινήσεσιν οὐκ ἰταμός*. F.

tender flesh, not exactly firm nor yet extremely fat; by leanness of the shoulders, neck, face, and neighbouring regions; by shoulder-blades closely knit and the parts below slack;[1] by supple sides; a somewhat gaunt back; a clear pinkish hue over the body; a thin skin; a small growth of hair, neither very coarse nor very black; and moist, gleaming eyes. *Dullness of sense* is indicated when the back of the neck and the legs are fleshy and stiffly fitted and knitted; the hip-joint round; the shoulder-blades high-set; the forehead big, round, and fleshy; the eyes pale and vacant; the legs thick and fleshy and round at the ankles; the jaws big and fleshy; loins fleshy; legs long; neck thick-set; the face fleshy and rather long. The manner of movement, gesture, and facial expression of the dull man, you may take it,[2] are analogous to his character.

Impudence is signified by small, bright, wide-open eyes, with heavy blood-shot lids slightly bulging;[3] high shoulder-blades; a carriage of the body not erect, but crouched slightly forwards; quickness of movement; a reddish hue over the body; with a sanguine complexion, a round face, and high chest. Signs of *Good Moral Character* are—a slow gait; a slow way of speaking with a breath-like and weak[4] voice; small eyes, black but not lustrous, not open and staring, nor yet mere slits; with a slow, blinking
808a movement of the lids—for rapid blinking signifies either cowardice or a hot temperament.

Good Spirits are indicated by a good-sized forehead, fleshy and smooth; the region of the eyes rather low; a rather drowsy-looking countenance, neither keen nor reflective. The gait, we may suppose, will be slow and languid, the gesture and facial expression those of a good but not a quick man. Signs of *Low Spirits* are—lean and wrinkled brows; enfeebled eyes (but you should notice that weak

[1] 807b 16. Read ἀνειμένα. Schneider.
[2] 807b 28. Read ἀναλάμβανε (F.) on evidence of Barth. Mess.
[3] 807b 30. Read παχέα, μικρὸν ἔγκυρτα.
[4] 807b 35. Read ἀσθενής. F. (Ia has ἀσθενές according to Bekker). Cp. Anon. de physiogn. liber, 107 'Vocem infirmi spiritus . . . κοιλοστομία.'

eyes may signify softness and effeminacy as well as dejection and low spirits);[1] a meek bearing and weary gait.

The *Pathic* is weak-eyed and knock-kneed; his head hangs on his right shoulder; his hands are carried upturned and flabbily; and as he walks he either wags his loins or else holds them rigid by an effort; and he casts a furtive gaze around, for all the world like Dionysius the Sophist.

Sulkiness is indicated by a snarling grin; a black complexion and withered skin; a gaunt, wrinkled face and the neighbouring regions furrowed with lines; and by straight black hair.

Men of *Fierce Temper* bear themselves erect, are broad about the ribs and move with an easy gait; their bodies are of a reddish hue,[2] their shoulder-blades set well apart, large and broad; their extremities large and powerful; they are smooth about the chest and groin; they have great beards, and the hair of the head starts low down with a vigorous growth.

Those of a *Gentle* disposition are robust-looking, well covered with plenty of moist flesh; well-sized men and well-proportioned; carrying themselves with head thrown back; and their hair starts rather higher up on the head than is usual.

The *Sly* man is fat about the face, with wrinkles round his eyes, and he wears a drowsy expression.

The *Small-Minded* have small limbs and small, delicate, lean bodies, small eyes and small faces, just like a Corinthian or Leucadian.

Men addicted to *Gaming and Dancing* have short arms, like weasels.

Railers have the upper lip updrawn, and the lower projecting,[3] and their hue is reddish.

The *Compassionate* are delicate, pale, and lustrous-eyed: the top of their nostrils is furrowed with lines, and they are always weeping. Such men are fond of women and beget

[1] 808a 8–11. Read *ἰσχνά, ὄμματα κατακεκλασμένα* (*ἅμα . . . σημαίνει, τὰ μὲν . . . θῆλυ, τὰ δὲ . . . ἄθυμον*), *ἐν τῷ κτλ.*, as F. suggests.

[2] 808a 20. Read *ὀρθὸς τῷ σχήματι, εὔπλευρος, εὔρυθμος, ἐπίπυρρος τὸ σῶμα.* F.

[3] 808a 33. Read *τὸ κάτω προπετές* with Schneider.

female children, and in character they are erotic and mindful of the past, with good natural parts and a fervid temper. The signs of these qualities have already been mentioned.
808b Compassion goes with wisdom, with cowardice, and with good moral character, hardness of heart with stupidity and effrontery.

Gluttony is indicated when the distance from navel to chest is greater than that from chest to neck.

Lasciviousness is indicated by a pale complexion, a heavy growth of straight, thick, black hair over the body, a heavy growth of straight hair on the temples, and small, lustrous, lewd eyes.

In the *Somnolent* the upper parts are disproportionately large: such men are bulky[1] and hot, and their flesh is firm.

Loquacity[2] is indicated by disproportionate size of the upper parts, with a round delicate build, and a thick growth of hair about the belly.

A *Good Memory* is signified when the upper parts are disproportionately small, and are delicate and tolerably well covered with flesh.

Soul and body, as it seems to me, are affected sym- 4
pathetically by one another: on the one hand, an alteration of the state of the soul produces an alteration in the form of the body, and contrariwise an alteration in bodily form produces an alteration in the state of soul. Grief and joy, to take an instance, are states of the soul, and every one knows that grief involves a gloomy and joy a cheerful countenance. Now if it were the case that the external expression persisted after the soul had got rid of these emotions,[3] we might still say that soul and body are in sympathy, but their sympathetic changes would not be entirely concomitant. As a matter of fact, however, it is obvious that every modification of the one involves a

[1] 808b 7. Read ὀγκώδεις with Rose.

[2] 808b 8. Read ἔχοντες. Λάλοι· οἱ τὰ ἄνω μείζω ἔχοντες καὶ γλαφυροὶ κτλ. F. following Schneider and Rose.

[3] 808b 17, 18. The passage is corrupt and the sense uncertain. The translation supposes that μένειν is nearer to the original than the better supported οὖσαν.

modification of the other. The best instance of this is to be found[1] in manic insanity. Mania, it is generally allowed, is a condition of the soul, yet doctors cure it partly by administering purgative drugs to the body, partly by prescribing, besides these, certain courses of diet. Thus the result of proper treatment of the body is that they succeed, and that too simultaneously, not only in altering the physical condition, but also in curing the soul of mania; and the fact that the changes are simultaneous proves that the sympathetic modifications of body and soul are thoroughly concomitant.

It is equally indisputable that differences in the soul's capacities are represented by corresponding physical traits, so that all the resemblances[2] in animals are indicative of some identity.

Again, if we consider the behaviour of animals, we find that some affections of the soul are peculiar to particular genera, whilst others are common to several, and that the peculiar activities are accompanied by peculiar, the common by common, physical traits. Examples of common characters are insolence, which is found in all animals with bushy tails, and violent sexual excitability,[3] which is found alike in asses and in dogs:[4] whilst on the other hand railing is a character peculiar to dogs, and insensibility to pain is peculiar to the ass. I have already explained how 809a
common and peculiar characters are to be distinguished.

At the same time it is only by long and wide experience that one can hope for oneself to attain detailed and expert understanding of these matters. For not only are visible characteristics of the body to be referred for explanation, as we are told, to analogies drawn partly from animals, partly from modes of action, but there are other external traits which depend on the varying proportions of bodily

[1] 808b 21. Read ⟨ἂν⟩ γένοιτο. F.

[2] 808b 29. Read ἅπαντα ⟨τὰ⟩ ὅμοια. Siebeck (*Gesch. d. Psych.* I. 2. 263) takes this to mean that 'alle Erscheinungen am lebendigen Wesen nur die Erscheinungsformen eines und desselben Princips seien' and speaks of 'organische Einheit', but it probably means merely that wherever you find similarity of external traits, you can reckon on some identity of character.

[3] 808b 34. Read ἔκστασις. Sylburg.

[4] 808b 36. Read κυνῶν for συῶν, as F. suggests.

heat and cold; and to add to the difficulty, some of these traits are very much alike and have not got distinctive names, as is the case e.g. with the paleness that results from terror and the paleness[1] due to fatigue. Now when the difference is so slight, it can hardly be discerned except by those whom practice has taught to appreciate the congruity of different shades of expression with different conditions of mind, and so the argument from congruity leads to the quickest and soundest conclusions,[2] and enables us to distinguish minute differences. It is a method generally useful, and particularly in the selection of physiognomic signs, for the signs selected must be congruous with what they stand for.[3]

Deduction also should be used in the selection of signs, whenever possible.[4] In the deductive procedure we attach to our data known attributes of them. For instance, if we have it given that a man[5] is an impudent blackguard and penurious, we can add that he will be a thief and a miser, the one as a consequence of his effrontery, the other as a consequence of his penuriousness. In all such cases we ought to include the deductive method in our procedure.

I WILL now first attempt to make a division of animals 5
by the marks in which they are bound to differ if they are respectively brave or timorous, upright, or dishonest. We have to divide the whole animal kingdom for this purpose into two physical types, male and female, and to show what mental attributes are congruous with each of these types. In all beasts that we try to breed[6] the female is tamer and gentler in disposition than the male, less powerful, more easily reared and more manageable. One may conclude from this that the female has a less spirited temper, and I think we find a parallel to this in ourselves, for when we are mastered by a fit of temper we become more obstinate[7] and totally intractable; we grow headstrong and violent

[1] 809a 10. Read *καὶ αἱ ἀπό*. F.
[2] 809a 14. Read *ἄριστος ⟨τρόπος⟩ ὁ*. F.
[3] 809a 18. A passage corrupt, perhaps beyond repair.
[4] 809a 20. Omit *ᾧ* and *τι*. F.
[5] 809a 21. Read *τις* for *τε*. F.
[6] 809a 30. Read *ἔστι δὲ ὁποῖα ἂν ἐπιχειρῶμεν τρέφειν*. F.
[7] 809a 35, 36. Read *δυσπαραπειστότεροι*. Sylburg.

and do whatever our temper impels us to do. Further, the female is, in my opinion, more mischievous than the male, and (though feebler) more reckless. Every one can 809b
see that this is so in women and in domesticated animals, and according to the unanimous evidence of herdsmen and hunters it is no less true of the beasts of the field. Moreover, it is beyond dispute that in every genus the head of the female is smaller than that of the male, her visage narrower, her neck thinner, her chest weaker, her sides of smaller build, and that, whilst her hips and thighs are fuller, she inclines to be knock-kneed, the lower parts of her legs are less stout, and her feet more delicately made: in short, the build of her body is pleasing to the eye[1] rather than imposing, and she is in comparison feeble and tender, and of moister tissue. The male is the opposite of all this[2]: his is the braver and more upright nature, whilst the female is the more timid and less upright.

This being so, the lion manifestly exhibits the male type in its most perfect form. He has a good-sized mouth: his visage is square and not too bony, the upper jaw level with the lower and not protruding: his nose you would call, if anything, rather thick: his gleaming eyes are deep-set, and neither absolutely round nor unduly long, and of moderate size:[3] his brow is of the right size, his forehead square and slightly hollowed from the centre, and over its lower part, towards the eyebrows and nose, there hangs a sort of cloud, and from the top of his forehead down to his nose there runs a ridge[4] of hairs sloping outwards: his head is of moderate size: his neck of due length and broad in proportion, with a tawny mane upon it, which is neither stiff and bristly nor yet too closely curled. About the clavicles he is supple and not too tightly articulated: his shoulders are stalwart, his chest powerful, his trunk broad, with sides and back to match: there is no superfluity of flesh on his haunches or thighs: his legs are powerful and

[1] 809b 10. Perhaps *ἡδίω καὶ ἀμαλεστέραν ἤ* with F. from Adamantius.

[2] 809b 12. F. rightly marks a lacuna after *ἐναντία*, to be filled by *ὥστε τοῦ μὲν ἄρρενος* or the like.

[3] 809b 20. Read *μετρίους*, as F. suggests.

[4] 809b 23, 24. Read *ἀνάσιλλον*. Sylburg. Cp. 812b 34.

sinewy, his gait vigorous, his whole frame well-knit and sinewy and neither too stiff nor too soft: he moves slowly with a large stride, rolling his shoulders as he goes. Such is his bodily appearance, and in soul he is generous and liberal,[1] proud and ambitious, yet gentle and just and affectionate to his comrades.

The panther, on the other hand, of all animals accounted brave, approximates more closely to the feminine type, save in its legs, which it uses to perform any feat of strength.[2]
810a For its face is small, its mouth large, its eyes small and white, set in a hollow, but rather flat in themselves: its forehead is too long and tends to be curved rather than flat near the ears: its neck too long and thin: its chest narrow and its back long: haunches and thighs fleshy: flanks and abdomen rather flat: its colour blotchy: and its whole body ill-articulated and ill-proportioned. Such is its bodily aspect, and in soul it is mean and thievish, and in a word, a beast of low cunning.

I have now described the more notable examples of the male and the female types of body to be found among animals accounted brave, and the characterization of the remainder will present no difficulty. I will next proceed to explain in a chapter on selection of signs what marks derived from animals the student of physiognomics should take into consideration.

THE accepted doctrines of the semeiotics of human 6
character are as follows:

A large and shapely *foot*, well-articulated and sinewy, is held to signify a strong character. For evidence we are referred to the male sex in general. A small, narrow, ill-articulated foot, pretty but weak, signifies a soft character, as in the female sex. Curved toes are a sign of impudence, and so are curved nails, on the evidence of birds with curved claws, whilst toes that are not properly divided indicate timidity, as in web-footed water-birds.[3]

[1] 809b 34. Read *ἐλευθέριον*. Gesner.
[2] 809b 38. Read *ἐνεργεῖ*, as F. suggests.
[3] 810a 23, 24. Read *ὄρνιθας τοὺς στεγανόποδας*. Gesner.

Ankles sinewy and well-articulated mark a strong character, on the evidence of the male sex; fleshy and ill-articulated ankles, a soft character, on the evidence of the female sex.

When the *lower leg* is at once well-articulated and sinewy and stalwart, it signifies a strong character, as in the male sex: when it is thin and sinewy it signifies loquacity,[1] as in birds. When it is full and almost bursting, it signifies by congruity blatant effrontery.

Knock-knees are a sign of the pathic, by congruity.

Thighs bony and sinewy indicate a strong character, as in the male sex: but when bony and full, a soft character, as in females.

Buttocks pointed and bony are a mark of a strong 810b character, as in males: fat fleshy buttocks of a soft character, as in females, whilst lean buttocks which look as if they had been rubbed bare, are indicative of a mischievous disposition, as in apes.

A narrow *waist*[2] marks the hunter, as in the lion,[3] and you will find that the best hunting dogs also are narrow in the waist.

A loose build round about the *belly* indicates strength of character, as in the male sex, whilst the opposite is by congruity indicative of a soft character.

A well-sized and sturdy *back* marks strength, and a narrow feeble back softness of character, as in males and females respectively.

Strong *sides* indicate strength and weak sides softness, as in males and females respectively, whilst swollen inflated sides signify aimless loquacity, as in frogs.[4] When the distance from navel to infra-sternal notch exceeds that from the notch to the neck, it is a mark of gluttony and of

[1] 810a 31. Read *λάλοι*, as F. suggests.

[2] 810b 4. Barth. translates 'bene lumbosi'. The correction of *ζωνοί* into *εὔζωνοι* dates from Gesner and Porta. But Porta seems right in saying 'potius succinctos, et graciles, quam lumbosos interpretandum', if one looks at actual specimens.

[3] 810b 5. Omit *καὶ τοὺς κύνας* as F. suggests. Cp. 811a 21, 812a 10, where the author is evidently adding instances from dogs to the accepted examples.

[4] 810b 16. Omit *τοὺς βοῦς ἢ ἐπί* with F. as a variant on *βατράχους*.

dullness of sense, of gluttony because there is so large a receptacle of food, and of dull sense because the seat of the senses is correspondingly confined and compressed[1] by the receptacle of food, so that the senses have become stupefied by repletion of the stomach rather than, as is usual, by inanition.[2]

A large well-articulated *chest* signifies strength of character, as in males.

When the *upper part of the back* is large and well covered with flesh and well-knit, the character is strong, as in males: when it is feeble and gaunt and ill-knit, the character is soft, as in females. When it is very much bent and the shoulders fall in upon the chest, it is argued by congruity to signify a mischievous disposition, since the front parts of the body, which ought to stand clear to view, become invisible. When it is curved backwards, it signifies vanity and lack of intelligence, as in the horse. So it must not be either convex or concave; and something intermediate between these extremes, therefore, should be looked for as marking a man of good natural parts.

When the *shoulders* and the back of the neck are well-articulated, they signify a strong character, whilst weak and ill-articulated shoulders signify a soft character, the
811a reference being to the sexes, as I explained when speaking of feet and thighs. Supple shoulders signify liberality of soul,[3] the argument being based on the external appearance, with which liberality seems to be congruous. On the other hand, stiff, clumsy shoulders indicate an illiberal disposition, also by congruity.

Suppleness of the *clavicles* signifies quickness of perception, for when the collar-bone is supple, stimulation of the senses is rendered easy.[4] Contrariwise, a stiff collar-bone indicates dullness of sense, because then it is difficult to apprehend sense-stimuli.

[1] 810b 21. Read *συνεωσμένον*. F.

[2] 810b 23. Read ⟨*μᾶλλον*⟩ *ἢ ἐνδείας*. F.

[3] 811a 2. Read *ἐλευθέριοι*. F.

[4] 811a 5–10. With a supple collar-bone it is easy, with a stiff one difficult, to move the head and so adjust the facial sense-organs to stimuli.

A thick *neck* indicates a strong character, as in males: a thin neck, weakness, as in females: a neck thick and full, fierce temper, as in bulls:[1] a well-sized neck, not too thick, a proud soul, as in lions: a long, thin neck, cowardice, as in deer: an unduly short neck, a treacherous disposition, as in wolves.

Lips thin and pendulous at their points of junction, such that part[2] of the upper lip overhangs the lower at the corners, signify pride of soul. The reference generally given is to the lion, but you may see the same thing as well in large and powerful breeds of dogs. Lips thin and hard with a prominence about the eye-teeth are a sign of base breeding,[3] on the evidence of swine. Thick lips, with the upper overhanging the lower, mean folly, as in the ass and the ape. Projecting upper lip and gums mark the railer, on the evidence of dogs.

A *nose* broad[4] at the tip means laziness, as witness cattle: but if thick from the tip, it means dullness of sense, as in swine; if the tip is pointed, irascibility, as in dogs; whilst a round, blunt tip indicates pride, as in lions. Men with a nose thin at the tip have the characteristics of birds. When such a nose curves slightly right away from the forehead, it indicates impudence, as in ravens: but when it is strongly aquiline and demarcated from the forehead by a well-defined articulation, it indicates a proud soul, as in the eagle; and when it is hollow, with the part next the forehead rounded and the curve rising upwards, it signifies lasciviousness, as in cocks.[5] A snub nose means lasciviousness, as in deer. Open nostrils are a sign of 811b
fierce temper, for they enter into the facial expression of temper.

[1] 811a 14. Omit θυμοειδεῖς. F.
[2] 811a 19. Read ὥστε τι for ὡς ἐπί. F.
[3] 811a 23. Read ἀγεννεῖς. Bonitz.
[4] 811a 28. Read πλατεῖαν.
[5] 811a 37 ff. Like Porta 'gallos consuluimus' 'cum eiusmodi nasum ignoraremus.' F. reads πρὸς τὸ μέτωπον and suggests καταφερῆ for περιφερῆ. But this does not much improve the sense. Porta translates 'incavus nasus ante frontem, rotundus, et supereminens [i.e. the comb] rotundum', which, as his illustration shows, gives a sense not far from the actual appearance, if it could be got from the text. Either the text is corrupt, or the author had not kept poultry.

The *face*, when fleshy, indicates laziness, as in cattle: if gaunt, assiduity, and if bony,[1] cowardice, on the analogy of asses and deer. A small face marks a small soul, as in the cat and the ape: a large face means lethargy, as in asses and cattle. So the face must be neither large nor little: an intermediate size is therefore best. A mean-looking face signifies by congruity an illiberal spirit.

As to the *eyes*, when the lower lids are pendulous and baggy, you may know a bibulous fellow, for heavy drinking[2] produces bagginess below the eyes: but when the upper lids are baggy and hang over the eyes,[3] that signifies somnolence, for on first waking from sleep our upper lids hang heavily. Small eyes mean a small soul, by congruity and on the evidence of the ape: large eyes, lethargy, as in cattle. In a man of good natural parts, therefore, the eyes will be neither large nor small. Hollow eyes mean villainy, as in the ape: protruding eyes, imbecility, by congruity and as in the ass. The eyes, therefore, must neither recede nor protrude: an intermediate position is best. When the eyes are slightly deep-set, they signify a proud soul, as in lions: and when a little deeper still,[4] gentleness, as in cattle.

A small *forehead* means stupidity, as in swine: too large a forehead, lethargy, as in cattle. A round forehead means dullness of sense, as in the ass: a somewhat long and flat forehead, quickness of sense,[5] as in the dog. A square and well-proportioned forehead[6] is a sign of a proud soul, as in the lion. A cloudy brow signifies self-will, as in the lion and the bull: a taut brow is taken from observation to mark the flatterer, and you may notice how a dog's brow smooths out when he fawns upon you.[7] So, a cloudy
812a brow indicating self-will and a smooth brow obsequiousness,

[1] 811b 7. Read ὀστώδη as F. suggests (cp. Ps. Pol. § 179).
[2] 811b 15. Read ἐμπεπωκόσι. Schneider.
[3] 811b 16. Read κύστιδες. ⟨οἷς δὲ τὰ ἐπὶ τοῖς ὀφθαλμοῖς οἷον κύστιδες⟩ ἐφεστήκασι. F. after Taube. Or, better, οἷς δὲ τὸ κτλ., to match l. 13.
[4] 811b 27. But not unduly deep. Or read with Kekulé, ἐπίπεδοι, 'flat'.
[5] 811b 32. Read εὐαίσθητοι. F. reads αἰσθητικοί; cp. 812a 6.
[6] 811b 33. Read τὸ μέτωπον. Wachsmuth.
[7] 811b 37. Omit οἱ κύνες. F.

the proper condition must be intermediate between these extremes. A scowling brow means a morose disposition, for we observe that vexation is thus expressed: a downcast brow means querulousness, as may also be verified by observation.

A large *head* means quickness and a small head dullness of sense, on the evidence of the dog and the ass respectively. A peaked head means impudence, as in those birds which have curved claws.

Men with small *ears* have the disposition of monkeys, those with large ears the disposition of asses, and you may notice that the best breeds of dogs have ears of moderate size.

Too black a *hue* marks the coward, as witness Egyptians and Ethiopians,[1] and so does also too white a complexion, as you may see from women. So the hue that makes for courage must be intermediate between these extremes. A tawny colour indicates a bold spirit, as in lions: but too ruddy a hue marks a rogue, as in the case of the fox. A pale mottled hue signifies cowardice, for that is the colour one turns in terror. The honey-pale are cold, and coldness means immobility, and an immobile body means slowness. A red hue indicates hastiness, for all parts of the body on being heated by movement turn red. A flaming skin, however, indicates mania, for it results from an overheated body, and extreme bodily heat is likely to mean mania.

A fiery colour on the chest signifies irascibility, for it is part of the expression of the onset of anger. Swollen veins on the neck and temples also signify irascibility, being part of the expression of anger. A face that reddens easily marks a bashful man, for blushing is an expression of bashfulness. But when the jowl goes red, you have a drunkard, for a red jowl is an expression of heavy drinking: whilst eyes that flush red indicate uncontrollable temper, for in a wild outburst of temper the eyes flush red. If the eyes are too black, they signify cowardice, for we saw above 812b
that this is the signification of too black a hue: if they are not too black, but inclining to chestnut, they indicate a bold

[1] 812a 12. Read Αἰγυπτίους ⟨καὶ⟩ Αἰθίοπας. Franz.

spirit. Grey or white eyes indicate cowardice, for we saw above that this is the signification of a white hue: but if they are gleaming rather than grey, they mean a bold spirit, as in lions and eagles. Goatish[1] eyes mean lustfulness, as in goats: fiery eyes, impudence, as in dogs: eyes pale and mottled, cowardice, for in terror the eyes go pale with splotches of colour: glistening eyes, lasciviousness, on the analogy of the cock and the raven.

Hairy legs mean lasciviousness, as in goats. Too much hair on breast and belly means lack of persistence, as argued from birds, in which this bodily characteristic is most developed; but breasts too devoid of hair indicate impudence, as in women. So both extremes are bad, and an intermediate condition must be best. Hairy shoulders mean lack of persistence, on the analogy of birds: too much hair on the back, impudence, as in wild beasts. Hair on the nape of the neck indicates liberality, as in lions: hair on the point of the chin,[2] a bold spirit, on the evidence of dogs. Eyebrows that meet signify moroseness, by congruity: eyebrows that droop on the nasal[3] and rise on the temporal side, silliness, as is seen in swine. When the hair of the head stands up stiff, it signifies cowardice, by congruity, for fright, as well as cowardly disposition, makes the hair stand on end: and very woolly hair also signifies cowardice, as may be seen in Ethiopians. Thus extremely bristly and extremely woolly hair alike signify[4] cowardice, and so hair gently curling at the end will make for boldness of spirit, as is to be seen in lions. A ridge of hair[5] on the upper part of the forehead indicates a liberal disposition, as in the lion: but a growth of hair on the forehead down by
813a the nose[6] indicates illiberality, the argument being from congruity, because such a growth presents a servile appearance.

[1] 812b 6, 7. Read αἰγωποί. Gesner, &c. But no reading suggested is very satisfactory.

[2] 812b 24. Clearly the meaning must, as Porta points out, concern hair. Porta suggests μακρογένειοι, but it is doubtful whether this could mean 'with a long beard', nor have most dogs long beards. The passage remains uncertain, but it does not mean 'with a long chin'.

[3] 812b 26. Read πρὸς τὴν ῥῖνα. Schneider.

[4] 812b 32. Read ἐμφαίνουσι. F.

[5] 812b 34, 35. Read ἀνάστιλλον. But the whole sentence is corrupt. See F.'s note.

[6] 812b 36. Omit ἐπὶ τῆς κεφαλῆς. F.

A long and slow *step* indicates a mind slow to begin, but persistent when started, for the length of the stride shows determination, but its slowness procrastination. A short slow step means tardiness without persistence, for shortness and slowness do not indicate determination. A long quick step means enterprise[1] and persistence, for its speed indicates enterprise and its length determination.[2] A short quick step signifies enterprise without persistence.

Identical references are made about *gesture* of hand, elbow, and arm.[3] To hold one's shoulders straight and stiff and roll them as one walks signifies a vainglorious spirit,[4] on the analogy of the horse: but to roll[5] the shoulders if one stoops a little forwards means a proud soul, as in the lion. To walk with feet and legs bent out means effeminacy,[6] as being a characteristic of women. To keep turning and bending[7] the body is a sign of obsequiousness, for that is the gesture of the flatterer. To walk with a stoop to the right is by congruity of appearance held to argue a pathic.

Mobile *eyes* signify keenness and rapacity, as in hawks: blinking eyes, cowardice, for flight begins with the eyes. Sidelong leering glances are held to be characteristic of a fop,[8] and so are drooping movements of one lid half over a motionless eye, and an upward roll of the eyes under the upper lids[9,10] with a tender gaze and drooping eyelids, and in general all tender melting glances; we argue partly from congruity, partly from the fact that these looks are common in women. A slow movement of the eyes which allows a tinge of white to show all the time, so that they look stationary,[11] indicates a reflective character;

1 813a 7. Omit *οὐκ*. Willich.
2 813a 8. Read *ἐπιθετικόν* for *τελεστικόν*, and omit *οὐκ*. F.
3 813a 10, 11. Read *ἀναφοραί* for *ἀναφέρονται*.
4 813a 12. Read *γαυροαλαζόνες*. Sylburg.
5 813a 13. Read *ἐπισαλεύοντες* with the Cod. Ambros.
6 813a 15. Read *θήλεις*.
7 813a 16. Read *ἐγκλινόμενοι* for *ἐντριβόμενοι*. F.
8 813a 21. Read *οἱ κατιλλαίνοντες* (Hemsterhuis), or *κατιλλαυταὶ ὡραϊσταί*. F.
9 813a 23. Read *ὑπὸ τὰ ἄνω βλέφαρα*. F.
10 813a 24. Read *ὄψεις*. Sylburg.
11 813a 29. Read, perhaps, *ὥσπερ ἑστηκότι*. But the whole passage seems to be corrupt.

for when the mind is absorbed in reflection, our eyes also are motionless.

A big, deep *voice* indicates insolence, as in the ass: a voice which, starting low, rises to a high pitch, indicates despondency and querulousness, the argument being partly from cattle and partly from congruity. Shrill, soft, broken
813b tones mark the speech of the pathic, for such a voice is found in women and is congruous with the pathic's nature. A deep, hollow, simple voice signifies a noble soul,[1] as in the stronger breeds of dogs, and also by the argument from congruity. A soft, languid voice means gentleness, as in sheep: a shrill, shrieking voice, lewdness, as in goats.

Men of abnormally small *stature* are hasty, for the flow of their blood having but a small area to cover, its movements are too rapidly propagated to the organ of intelligence.[2] Men of abnormally large stature, on the other hand, are slow, for the flow of the blood has to cover a large area, and its movements are therefore propagated to the organ of intelligence slowly. Small men with dry tissues, or of the hue that heat produces in the body, have not persistence enough to effect their purposes; for their blood flowing in a confined space, and at the same time, in consequence of the fiery condition of the body, flowing rapidly, their thought never keeps to a single topic, but is always passing to something new before being done with the old.[3] Again, big men with moist tissues or of the hue that results from cold, also lack persistence; for their blood flowing over a large area, and slowly, on account of the cold condition of the body, its movement does not manage to reach the organ of intelligence entire.[4] On the other

[1] 813b 2. Read βαρὺ κοῖλον φωνοῦσι μὴ πεπλεγμένον, and mark a lacuna after πεπλεγμένον. F. following Gesner.

[2] 813b 9. *Sc.* the heart. F. refers to Empedocles in Theophr. *De Sensu*, § 10, as confirming the view that τὸ φρονοῦν is the blood. But if τὸ φρονοῦν is the blood, then αἱ κινήσεις are not of the blood. Yet κινήσεως in l. 22 must refer to the blood. Moreover, ὑπερχωροῦσι in l. 33 becomes almost unintelligible, unless indeed a distinction is drawn between blood near the heart as the seat of intelligence and other blood as stimulating it. If, however, τὸ φρονοῦν is the heart, αἱ κινήσεις are movements of the blood occasioned by stimuli, or at any rate conveying stimulation to the heart.

[3] 813b 16. Read τὸ περιόν. F.

[4] 813b 19, 20. Read οὐ συνανύει ἀφικνουμένη. F. (F. also inserts ἡ κίνησις before οὐ.)

hand, small men with moist tissues and of the hue that results from cold,[1] do effect their purposes; for their blood moving in a confined area, the less mobile[2] constituent in its composition produces a proportion[3] which conduces to effectiveness.[4] And again, big men with dry tissues, and of the hue that results from heat,[5] are also persistent, and are keen of sense; for the warmth of tissue and complexion counteracts the excessive size, so that a proportion conducive to effectiveness is attained. Such, then, are the conditions under which opposite extremes of stature tend now to effective activity, and now to ineffectiveness. But a stature intermediate between these extremes confers upon its possessors the greatest acuity of sense and the greatest general effectiveness, for on the one hand, movements of the blood, not having a long distance to travel, easily reach the reason, while on the other hand, not being confined in too small a space, they do not pass beyond their mark.[6] Thus the greatest tenacity of purpose and the greatest acuity of sense will be found in persons of moderate stature.

An ill-proportioned body indicates a rogue, the argument 814a
being partly from congruity and partly from the female sex. But,[7] if bad proportions mean villainy, a well-proportioned frame must be characteristic of upright men and brave: [only, the standard of the right proportions must be sought in the good training and good breeding of the body, and not in the male type, as determined at the beginning of this treatise].[8]

It is advisable, in elucidating all the signs I have mentioned, to take into consideration both their congruity with

[1] 813b 21. Read *χρώμασιν, ⟨ἃ⟩ διὰ ψυχρότητα γίνονται, ἐπιτελεστικοί.* F.
[2] 813b 22. *sc.* cold.
[3] 813b 23. *sc.* between size of body and speed of movement of blood, as in l. 26; not between constituents of the blood.
[4] 813b 23. Read *πρὸς τό* for *τὸ πρῶτον.* F.
[5] 813b 24, 25. Read *χρώμασιν, ⟨ἃ⟩ . . . γίνονται, ἐπιτελεστικοί.*
[6] 813b 33. Insert *οὐχ* with F., but retain *ὑπερχωροῦσιν.*
[7] 814a 1. Read *δέ* for *γάρ.* Sylburg.
[8] 814a 3–5. This passage is in complete contradiction to Chapter V and to the next paragraph. It must be regarded as an interpolation. It may be noted that only here in the *Physiognomonica* is *ἀναφέρειν* used with *πρός.*

various characters and the distinction of the sexes, which is, as I showed, the most complete distinction, the male being more upright and courageous and, in short, altogether better than the female. It will be found, moreover, in
814b every selection of signs that some signs are better adapted than others to indicate the mental character behind them. The clearest indications are given by signs in certain particularly suitable parts of the body. The most suitable part of all is the region of the eyes and forehead, head and face; next to it comes the region of the chest and shoulders, and next again, that of[1] the legs and feet; whilst the belly and neighbouring parts are of least service to physiognomics. In a word, the clearest signs are derived from those parts in which intelligence is most manifest.[2]

[1] 814b 6. Read *ἔπειτα ⟨τὰ⟩ περί*. F.

[2] 814b 8. Read *ἐπιφάνεια*, which gives a better sense than *ἐπιπρέπεια*. Barth. Mess. translates 'in quibus et sapientiae plurimae superapparentia fit'; and, as 'superapparens' is his term for *ἐπιφανής* and *ἐπιφαινόμενος*, his MS. must have read *ἐπιφάνεια*.

DE PLANTIS

BY

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F

PREFACE

The *De Plantis* is one of the least satisfactory of all the treatises which are included in the Aristotelian corpus.

Firstly, it was certainly not in its original form a work of Aristotle himself; E. H. F. Meyer,[1] who has devoted most time to the text and its elucidation, attributes it to Nicolaus Damascenus. Much of it undoubtedly shows Peripatetic influence, and it has therefore some interest as compensating for the scantiness of our information on botanical subjects in other Aristotelian treatises. The views expressed on sex in plants are of particular importance, as partly anticipating the results of modern botanical research.

Secondly, the text has passed through a chequered career and is in a deplorable condition. The original Greek text having been lost, the treatise was preserved in an Arabic translation, now also lost, which in its turn was translated into Latin during the thirteenth century by a certain Englishman, by name Alfredus,[2] whose knowledge of Arabic and whose Latin style leave something to be desired. The Greek text in Bekker's edition and the Teubner edition is a translation from the Latin back into Greek, and is therefore three times removed from the original.

The present translation has been made from the Latin version of Alfredus as edited by Meyer, to whose commentary I am deeply indebted. F. W. Wimmer's *Phytologiae Aristotelicae Fragmenta*[3] has also been found useful. It has been thought worth while to note parallels with

[1] *Nicolai Damasceni de Plantis Libri duo Aristoteli vulgo adscripti ex Isaaci ben Honaici versione Arabica Latine vertit Alfredus, recensuit* E. H. F. Meyer (Lipsiae, 1841).

[2] Meyer, pp. iv–ix.

[3] Vratislaviae, 1838 (one part only published).

other passages in Aristotle when it has been possible to trace them.

My sincere thanks are due to the kindness of Mr. W. D. Ross, who has read through the translation and made some valuable suggestions.

E. S. F.

CONTENTS

DE PLANTIS

BOOK I

1 Life is found in animals and plants; but while in animals 815a it is clearly manifest, in plants it is hidden and less evident. But before we can assert the presence of life in plants, a long inquiry must be held[1] as to whether plants possess a soul and a distinguishing capacity for desire and pleasure and pain. Now Anaxagoras and Empedocles[2] say that they are influenced by desire; they also assert that they have sensation and sadness and pleasure. Anaxagoras declared that plants are animals and feel joy and sadness, deducing this from the bending[3] of their foliage; while Empedocles held the opinion that sex has a place in their composition. Plato indeed declares[4] that they feel desire only on account of their compelling need of nutriment. If this be granted, it will follow that they also feel joy and sadness and have sensation. I should also like to reach some conclusion as to whether they are refreshed by sleep and wake up again, and also whether they breathe, and whether they have sex through the mingling of the sexes or not. But the great diversity of opinion on these subjects involves too long an inquiry, and the best course is to pass over these topics and not to waste time[5] on the unprofitable investigation of details. Some have asserted that plants have souls, because they have seen that they come to birth and receive nutriment and grow, and have the bloom of youth and the dissolution of old age—characteristics which nothing inanimate shares with plants; if

[1] Omitting *constaret enim* with the Basle MS.

[2] Reading here (and elsewhere) *Empedocles* for *Abrucalis*; Meyer shows that the doctrines attributed in this treatise to Abrucalis are those ascribed by other writers to Empedocles.

[3] Meyer defends the MS. reading *flexum* against the usual reading *fluxum*.

[4] *Timaeus* 77 A–C.

[5] Reading *morari* for *memorari*: the Greek version has ἐνδιατρίβειν.

plants possess these characteristics, they believed them also to be affected by desire.

815b Let us first examine their obvious characteristics, and afterwards those which are less evident. Plato[1] says that whatsoever takes food desires food, and feels pleasure in satiety and pain when it is hungry, and that these dispositions do not occur without the accompaniment of sensation. The view of Plato in thus holding that plants have sensation and desire was marvellous enough; but Anaxagoras and Democritus and Empedocles[2] declared that they possessed intellect and intelligence.[3] These views we must repudiate as unsound and pursue a sane statement of the case. I assert, then, that plants have neither sensation nor desire;[4] for desire can only proceed from sensation, and the end proposed by our volition changes in accordance with sensation. In plants we do not find sensation nor any organ of sensation, nor any semblance of it, nor any definite form or capacity to pursue objects, nor movement or means of approach to any object perceived, nor any token whereby we may judge that they possess sense-perception corresponding to the tokens by which we know that they receive nutriment and grow. Of this we can only be certain because nutrition and growth are parts of the soul, and when we find a plant to be possessed of such a nature, we perceive of necessity that some part of a soul is present in it; but we ought not to contend that a plant which lacks sensation is a thing possessed of sense, because while sensation is the cause of the glorification of life, nutrition is merely the cause of growth in the living thing.

These differences of opinion come into consideration in their own proper place. It is certainly difficult to find a state intermediate between life and the absence of life.
816a Some, too, will urge that a plant, if it be alive, is therefore an animal;[5] for it is difficult to assign any principle to the

[1] *loc. cit.*

[2] Meyer compares Sext. Empir. p. 512 *ὁ δὲ Ἐμπεδοκλῆς ἔτι παραδοξότερον πάντα ἠξίου λογικὰ τυγχάνειν, καὶ οὐ ζῷα μόνον ἀλλὰ καὶ φυτά, ῥητῶς γράφων· Πάντα γὰρ ἴσθι φρόνησιν ἔχειν καὶ νώματος αἶσαν.*

[3] Cf. *de anima* 403b 31 ff.

[4] The views here expressed follow closely those of *de anima* 414a 29 ff.

[5] i.e. that that which is living (*ζωόν*) is therefore an animal (*ζῷον*.)

life of plants except that of the life of nutrition. But, when men deny that plants have life, they do so because plants do not possess sensation; yet there are certain animals which lack foresight and intelligence.[1] For nature, which destroys the life of the animal in death, preserves it in the continuation of the race, and it is wrong for us to suppose any intermediate state between the animate and the inanimate. We know that sea-shells[2] are animals which lack foresight and intelligence and are at once plants and animals. The only reason, therefore, for their being called animals is that they have sensation; for genera give names and definitions to the species which fall under them, while the species give names to the individuals, and the genus ought to rest on a common cause present in the numerous individuals and not on the individuals themselves; but the meaning of the cause, on which the genus is based, is not obvious to every one. Now there are animals[3] which have no female sex, and some which do not procreate their kind, and some which lack the power of movement, and some in which the colour varies, and some which produce an offspring unlike themselves, and some which are produced from decaying vegetation.[4]

What, therefore, is the principle of life in animals? What is it that raises the noble animal, as surely as the heavens which encircle the sun and the planets, from the sphere of perplexity and doubt? For the heavenly bodies feel no outside influence, and sensation is an effect produced on a sentient being. Now a plant has no movement of itself, for it is fixed in the earth, which is itself immovable. Whence, then, shall we infer any similarity which may enable us to attribute life to the plant? For there is no

[1] The argument is that there are some animals which lack intelligence, but they do not therefore cease to be animals; so plants do not cease to be alive because they lack sensation.

[2] Cf. *H. A.* 588^b 12 ff.

[3] Various classes of animals are now enumerated, which though they differ in many respects yet all possess one thing, sensation, which puts them into the genus of animals.

[4] The text has *quae ex arboribus crescunt*, which is absurd and due doubtless to mistranslation. The reference is almost certainly to the production of animal life from the putrefaction of vegetable matter, cf. *H. A.* 539^a 23.

one thing which includes all three forms of life.[1] We therefore assert that sensation is common to all animal life, because sensation marks the distinction between life and death; but the heavens, which pursue a nobler and more sublime path than we do, are far removed from life and death. But it is fitting that animals should have[2] some common characteristic perfect in itself but less sublime, and this is the acquisition and deprivation of life. And one ought not to shrink from the use of these terms on the ground that there is no mean between the animate and the inanimate, between life and the deprivation of life; nay, there is a mean between life and the inanimate, because the inanimate is that which has no soul nor any portion of it. But a plant is not one of those things which entirely lack a soul, because there is some portion of a soul in it;[3] and
816b it is not an animal, because there is no sensation in it, and plants pass one by one gradually from life into death. We can put the matter in a different way and say that a plant is animate. I cannot, however, assert that it is inanimate as long as it possesses soul and some form of sensation; for that which receives food is not entirely without soul, and every animal has soul. But a plant is imperfect, and, whereas an animal has definite limbs, a plant is indefinite in form, and a plant derives its own particular nature from the motion which it possesses in itself.[4] Some one might say that a plant has soul, because the soul is that which causes motion and desire to arise locally, and motion can only arise locally when sensation is present. But the absorption of food is in accordance with a natural principle, and is common both to animals and plants, and no sensation at all will accompany the absorption of food; for everything that absorbs food employs two qualities in feeding, namely, heat and cold, and an animal properly requires moist food

[1] i.e. life as found in the heavenly bodies, in animals, and in plants. The reasoning is somewhat obscure, but seems to be that (1) animals have life and movement, (2) the heavenly bodies have a higher form of life and fixed movement, (3) plants have life but no movement.

[2] Reading *habeat*. [3] i.e. τὸ θρεπτικόν, cf. *de anima* 414a 29-32.

[4] The motion of plants is that which takes place in the absorption of food.

and dry food, for coldness is always found in dry food; for neither of these two natures[1] is ever unaccompanied by the other. And so food is continuously being supplied to that which feeds on it till the time when it begins to decay, and animals and plants have to be provided with food composed of the same elements as those of which they themselves are composed.

2 Let us now investigate what we have already mentioned, namely, desire in plants, their movement, and their soul, and that which is given forth[2] by them. A plant has not respiration, although Anaxagoras declared that it has;[3] and we even find many animals which have not respiration.[4] We can see by ocular demonstration that plants do not sleep and wake, for waking is due to an effect of sensation, and sleeping is an enfeebled condition of sensation,[5] and nothing of this kind is found in that which vegetates at all times in the same condition, and is itself naturally without sensation. When an animal takes food, a vapour rises from the food into its head and it falls asleep,[6] and, when the vapour which rises to its head is consumed, it wakes up. In some animals this vapour is plentiful and yet[7] they sleep but little. Sleep is the suppression of motion and this involves the quiescence of the thing moved.

The most important and appropriate subject of inquiry which arises in the science of botany is that proposed by 817a
Empedocles, namely, whether female and male sex is found in plants, or whether there is a combination of the two sexes.[8] Now we assert that when the male generates it generates *in* another, and when the female generates it generates *from* another,[9] and both are mutually separate. This is not found to be the case in plants; for in a particular species the produce of the male plant will be rougher,

[1] i.e. coldness and dryness.
[2] In particular, whether plants breathe, which is discussed in the next sentence.
[3] Cf. *de respir.* 470b 30.
[4] Cf. *ib.* 470b 9.
[5] Cf. *de somno* 454b 27 ff.
[6] Cf. *ib.* 456b 21 ff.
[7] Reading with MS. Bas. *quae tamen*.
[8] The whole of this discussion follows closely that in *G.A.* 731a 1–b 8.
[9] *ib.* 716a 21–23.

harder, and stiffer,[1] while the female will be weaker but more productive. We ought also to inquire whether the two kinds are found in combination in plants as Empedocles states that they are. But my opinion is that this is not the case, for things which mingle together ought first to be simple and separate, and so the male will be separate and the female separate ; they afterwards mingle, and the mingling will only take place when it is produced by generation. A plant, therefore, would have been discovered before the mingling had taken place, and it ought therefore to be at the same time an active and a passive agent in the process of production. The two sexes cannot be found combined in any plant ; if this were so, a plant would be more perfect than an animal, because it would not require anything outside itself in order to generate ; whereas the plant *does* require the right season of the year and sunshine and its natural temperature more than anything, requiring them at the time when the tree sprouts. The nutritive principle in plants is derived from the earth, the generative principle is derived from the sun. Wherefore Anaxagoras said that the seeds of plants are borne down from the air, and other philosophers who profess the same doctrine call the earth the mother and the sun the father of plants.[2] But we must suppose that the mingling of the male and the female in plants takes place in some other way, because the seed of a plant resembles the embryo[3] in animals, being a mixture of the male and female elements. And just as in an egg there exists the force to generate the chicken and the material of its nutriment up to the time when it reaches perfection and emerges from the egg, and the female lays the egg in a short space of time ; so too with the plant. And Empedocles is right when he said the tall trees bear

[1] *plantae . . . ex ea*, the Latin text is evidently corrupt, but the Greek translation seems to give the right sense.

[2] Meyer shows that in this passage *frigus* and *lechineon* are corruptions due to a misunderstanding of the Arabic, and restores the sense of the passage as follows : *Estque principium nutritionis plantarum a terra, generationis earum a sole. Quare Anaxagoras dixit earum semina ex aere deferri, aliique philosophi, eandem doctrinam profitentes, terram matrem, solem autem patrem plantarum esse.* Cf. *G.A.* 716a 15 ff.

[3] *impraegnatio* no doubt represents the Aristotelian κύημα.

their young;[1] for that which is born can only be born from a portion of the seed, and the rest of the seed becomes at first the nutriment of the root; and the plant begins to move[2] as soon as it is born. This, then, is the opinion which we ought to hold about the mingling of the male and female in plants, similar to that which we hold about 817b
animals. This process is the cause of plants under a certain disposition of circumstances; for in the case of an animal when the sexes mingle and afterwards separate a single offspring is produced from them both. But this is not the case with plants; when the sexes mingle, it is the forces of the sexes which mingle.[3] And if nature has mingled the male and the female together, she has followed the right course; and in plants the only operation which we find is the generation of fruits; and an animal is only separated at the times when it is not having sexual intercourse, and this separation is due to its multifarious activities and intellectual pursuits.

But there are some who hold that the plant is complete and perfect because of its possession of these two powers,[4] and because of the food which is adapted to feeding it, and the length of its existence and duration.[5] When it bears leaves and fruit its life will continue and its youth return to it. No excrement[6] will be produced from plants. A plant does not require sleep for many reasons, for it is placed and planted in the earth and attached to it and has no movement of itself, nor has it any definite bounds to its parts, nor does it possess sensation or voluntary motion, or a perfect soul; nay, it has only part of a soul.[7] Plants

[1] Cf. Empedocles (Diels, *Vorsokr.* fr. 79)

οὕτω δ' ᾠοτοκεῖ μακρὰ δένδρεα, πρῶτον ἐλαίας.

[2] i.e. in growth.

[3] The writer seems to be arguing that the process of sexual intercourse in plants and animals is radically the same; but while in animals the sexes are separated and have to come together for sexual intercourse, in plants the forces of the two sexes are combined, and the result of this combination is shown in the production of fruits. Following Meyer, the words *commiscentur vires sexuum* (817b 4) and *postquam separati sunt* (817b 7) have been omitted.

[4] i.e. male and female sex.

[5] Cf. *de long. et brev. vit.* 467a 6 ff.

[6] *Superfluum*=περίττωμα, *P. A.* 650a 22.

[7] *Partem partis animae*, an Arabic turn of expression=*aliquam partem animae*.

are only created for the sake of animals, and animals are not created for the sake of plants. Some one will urge that a plant requires food which is easily obtained and poor, yet it needs it very regularly and continuously, and without interruption. If it were agreed that a plant has an advantage over an animal, it would follow that things which are inanimate[1] were better and nobler than those which are animate; yet we see that the function of the animal is nobler and better than that of the plant, and we find in the animal all the virtues which are present in the plant and many others.[2] Empedocles said that plants had their birth when the world was yet small and its perfection not attained, while animals were born after it was completed.[3] But this account of creation does not suit the facts, for the world as a whole has existed continuously from eternity and has never ceased to produce animals and plants and
818a all their species. In every kind of plant there is natural heat and moisture, and, when these are consumed, the plant will become weak and grow old and decay and dry up.[4] Some people call this corruption, others do not.

SOME trees contain a gummy substance, such as resin 3
and almond-gum and myrrh, and frankincense, and gum-arabic. Some trees have fibres[5] and veins and flesh[6] and wood and bark and marrow within them; some trees consist almost wholly of bark. In some the fruit is underneath the bark, that is, between the bark and the wood. Some parts of the tree are simple, such as the moisture found in it and the fibres[5] and veins; other parts are

[1] i.e. only partly possessed of ψυχή or *anima*. The suggested advantage is that it can subsist on easily obtained and poor nutriment, —it has, however, the disadvantage that it requires this constantly.

[2] Cf. *H. A.* 588b 7 ff.

[3] Meyer compares Plut. *de Plac. Phil.* v. 26 Ἐμπεδοκλῆς πρῶτα τῶν ζῴων τὰ δένδρα ἐκ γῆς ἀναδῦναί φησι, πρὶν ἥλιον περιαπλωθῆναι καὶ πρὶν ἡμέραν καὶ νύκτα διακριθῆναι.

[4] Cf. *de long. et brev. vit.* 466a 18 ff.; *de respir.* 478b 27.

[5] Meyer shows that the origin of this chapter is Theophr. *Hist. Plant.*, and that several words have been mistranslated in the Arabic or Latin version. *Nodi et venae* are the ἶνες (*fibrae*) καὶ φλέβες of Theophr. *l. c.* i. 2, 5.

[6] *Lignum et ventrem* are the ξύλον καὶ σάρκα of Theophr. *l. c.* Meyer shows that there is a mistranslation due to a confusion of the Arabic *mad* (=*carnem*) and *maadd* (=*ventrem*).

composite,[1] such as the branches and twigs and the like. These are not all found in all plants; for some have composite and some simple parts, while others do not have them. Some plants possess various other parts as well (roots, twigs), leaves,[2] pedicels,[3] flowers, catkins, tendrils,[4] and bark surrounding the fruit.

Just as in the animal, so also in the plant there are members consisting of similar parts, and some of the parts of a plant are composed of other members. The bark of a plant resembles the skin of an animal, while the root of a plant is like the mouth of an animal,[5] and its fibres[6] are like an animal's muscles, and so with its other parts. Any of these parts can be divided on one principle into similar parts, or a division can be made by dissimilar parts[7] (just as mud can be divided in one way into particles of earth only and in another into particles of water; [8] similarly the lungs and flesh can be divided up on one principle so that they are pieces of flesh, while on the other principle they can be divided into their elements or radical parts). But a hand cannot be divided up into another hand, nor a root into another root, nor leaves into other leaves; but these roots and leaves are themselves the result of composition. Some fruits are composed of few parts, some of many—olives, for example, which are made up of bark and a fleshy substance and a shell and a seed. Some fruits have as many as three coverings. All seeds consist of two bodies.[9] We have now mentioned the parts of which individual plants consist. The conclusion of our discussion is this: it is a difficult task to determine the parts of the

[1] Omitting *ex his* with the Basle MS.

[2] The words *radices*, *virgas* are probably interpolated: they do not occur in the parallel passage of Theophr. (*l. c.* 2, 1), and *virgae* have been named already, while all plants have *radices*.

[3] *Ramos* have already been mentioned, the word probably represents the *μίσχος* (*pediculus*) of Theophr.

[4] *Pullulationes* are probably the *βρύα* of Theophr., and *rotunditatem* represents ἕλιξ.

[5] Cf. *G. A.* 412b 3; *de iuv. et sen.* 468a 9.

[6] *Nodos*=*fibras* as above.

[7] Cf. *H. A.* 486a 5 ff. and D'A. W. Thompson's note.

[8] The latter is an example of division by dissimilar parts, mud being divided into its component parts, earth and water; the division by similar parts would be into particles of mud.

[9] Cf. above 817a 37.

plant in general,[1] and its coverings and its variations, and in particular, to define its essential nature and its colour, and the period of its duration, and the effects which are produced upon it. Plants have not fixed habits of mind
818b and the power of action like that possessed by animals;[2] and if we compare the parts of an animal with those of a plant, our discussion will be a long one, and we shall not avoid considerable differences of opinion in naming the parts of plants. For a part of a thing is of its own kind and of its own particular substance, and, when it is once produced, any special part[3] will remain in its original condition, unless it departs from it owing to some long continued infirmity. Flowers, fruits, and leaves will, in some cases, be produced annually, in others they are perennial;[4] they have not the same permanence as the bark and body of a plant (though even this is shed under the influence of burning heat, being stripped off by the desert wind[5]). . . .[6] This does not happen in plants; for various undetermined parts of plants are often shed (like hair in the case of man and claws in the case of animals), and in their stead other parts grow either where the lost parts were, or elsewhere in some other place. It is clear from this that it is not determined whether the parts of a plant are really parts or not. It is wrong for us to say that those things with which a plant[7] grows and by which it reaches completion are not parts of it; but the leaves and everything that is found in a plant[8] are parts of that plant, although they are not determined and are gradually shed; for the antlers of a stag and the hair of

[1] Emphasis must be put upon the numbers of *plantarum* and *plantae*; the sense is that it is easy to name the various parts of individual plants, but difficult to lay down definitions which will apply to the plant *καθόλου*. Meyer compares Theophr. *l. c.* 1, 10 *ὅλως πολύχουν τὸ φυτὸν καὶ ποικίλον, καὶ χαλεπὸν εἰπεῖν καθόλου.*

[2] Cf. Theophr. *l. c.* 1, 1 *ἤθη γὰρ καὶ πράξεις οὐκ ἔχουσιν ὥσπερ τὰ ζῷα.*

[3] '*Speciem* pro *parte speciali*' (Meyer).

[4] These words can only apply to *folia*; the author is thinking of evergreens.

[5] The words *a re* and *causam* are manifestly corrupt. Meyer ingeniously suggests that *re* is the Arabic *raie* (a hot desert wind), and that *causam* is a corruption of *cauma*.

[6] Meyer supposes a lacuna here, otherwise there is nothing for *istud* in the next sentence to refer to.

[7] Omitting *animal* which destroys the sense.

[8] Reading *illa* with G. II.

certain animals, and the fur of certain of those which hibernate in hollows underground, fall off, and this process resembles the shedding of leaves.[1]

We ought, therefore, to treat of the subjects which we mentioned first, and begin by enumerating the parts which are peculiar to certain plants and those which are common to all, and their differences. Let us say, therefore, that there is a great diversity in plants in respect of number and fewness, largeness and smallness, and in respect of strength and weakness. The reason of this is that the moisture[2] which is found in large trees, is in some trees, the fig, for example, like milk, in others it is like pitch, as in the pine, in others it is watery,[3] like the liquid found in the vine, in others it is acrid,[4] like that found in marjoram and in the herb called opigaidum.[5] There are also plants which have their parts dry. Some plants have their parts well defined, and neither alike nor equal in size; others have parts which are similar to one another but not equal, in others they are equal but not similar, and their position is not fixed.[6] The differences of plants are recognized in their 819a parts, their form[7] and colour and sparseness and density and roughness and smoothness, and all[8] their incidental differences of taste,[9] their inequality of size, their numerical increase and decrease, their largeness and smallness. Some plants, too, will not be uniform, but will show great variation, as we have already said.

4 Some plants produce their fruit above their leaves, others beneath; in some plants the fruit is suspended from the stock of the tree, in others it grows from the root, as in the

[1] Cf. Theophr. *l.c.* i. 1, 3.

[2] The Aristotelian doctrine that moisture is the principle of plants is here again emphasized. Cf. above, 818a 2 and note.

[3] Meyer adds here *ut in abiete et in quibusdam est aquosus*, comparing Theophr. *l. c.* 12, 2 ἡ δὲ πιττώδης οἷον ἐλάτης . . . ἄλλη δ' ὑδαρὴς οἷον ἀμπέλου.

[4] The MSS. read *originalis* which makes no sense; Meyer reads *origanalis*, 'like marjoram,' i.e. 'bitter, acrid,' but the word is probably corrupt.

[5] This word is hopelessly corrupt.

[6] '*Non est locus in situ*, i.e. *locus non est definitus*' (Meyer).

[7] *Figurae*, &c.. 'vertendum potius fuisse arbitror *cognoscitur et figura et colore*,' &c. (Meyer).

[8] '*Omnia* vertendum fuisset *omnibus*' (Meyer).

[9] Meyer adds *saporum* from Theophr. *l.c.* § 6 διαφοραὶ τῶν χυλῶν.

Egyptian trees which are called vargariaton[1]; in some cases it grows in the middle of the plant. In some plants the leaves and knots[2] are not separated; in others the leaves are equal in size and similar to one another, and some of those which have branches have branches equal in size. The following parts, which we will name, are found in ⟨almost⟩ all plants,[3] and admit of growth and addition—namely, the root, the shoots, the stem, and the branches; these resemble the limbs of animals which include all the other limbs. The root acts as an intermediary between the plants and its food, and for that reason the Greeks call it the root and cause of life in plants, for it supplies the plant with its means of life. The stem is the only part which grows out of the ground and forms, as it were, its erect stature. The suckers are the parts which sprout from the root of a tree, while the branches are above the suckers. They are not found in all plants; and in some plants which have branches these are not permanent, but only last from year to year. There are plants which do not have branches or leaves, fungi, for example, and mushrooms. Branches are only found on trees. Bark and wood and the pith of a tree are produced from moisture; some call this pith the womb of the tree, others the vitals, others the heart. The fibres[4] and veins and flesh of the whole plant are made up from the four elements. Parts are often found which are adapted to reproduction, leaves, for example, and flowers and small twigs (which are flowers outside the plant);[5] the fruit and leaves on a plant grow in the same way, being produced[6] from the seed and the shell which surrounds it.

Of plants some are trees, some are midway between trees

[1] This word is clearly corrupt; it perhaps represents the *ἀράχιδνα* of Theophr. *l.c.* 12, 7.

[2] *Nodi* is here, according to Meyer, used in its proper sense of knots (*ὄζοι*) and not in the sense of *ἶνες* (*fibrae*) as in 818a 6 and 11.

[3] *Omnium plantarum* can hardly be right here, for it is stated below (l. 30) that *rami* are not found in all plants. The parallel passage of Theophr. *l.c.* 1, 9 has *ἔστι (τὰ μέρη) καὶ μέγιστα καὶ κοινὰ τῶν πλείστων, ῥίζα, κτλ.*

[4] See notes on 818a 6, 819b 13.

[5] These words are certainly corrupt: the parallel passage in Theophr. *l.c.* 2, 1 has *μίσχος· τοῦτο δ᾽ ἐστὶν ᾧ συνήρτηται πρὸς τὸ φυτὸν τὸ φύλλον καὶ ὁ καρπός.*

[6] Omitting *quae.*

and herbs and are called bushes,[1] some are herbs, and some are vegetables. Almost every plant falls under one of these classes. A tree is a plant which has a stem growing from its root, from which stem numerous branches grow, olive-trees, for example,[2] and fig-trees. A plant which is something between a tree and a small herb, and is called a bush, has many branches growing out of its roots, like the thorn-tree[3] and bramble. Vegetables are plants which have a number of stems growing out of one root and a number of branches, rue, for example, and cabbage. Herbs are plants which have no stem, but their leaves grow out of their roots. Some plants are produced and dry up every year, wheat, for example, and vegetables. We can only indicate these various classes of plants by general inferences, and by giving examples and descriptions. Some plants verge on two very different classes, mallow,[4] for example (since it is both a herb and a vegetable), and likewise beet. Some plants grow at first in the form of low bushes[5] and afterwards become trees, as, for instance, the nut-tree, the chaste-tree, and the plant called 'goatberry'.[6] Perhaps myrtles, apple-trees, and pear-trees fall also under this class, for all of them have a number of superfluous stems growing from their roots. It is worth while to specify these that they may serve for purposes of example and inference, but we must not investigate the definitions of every kind of plant.

Some plants are indoor plants, others garden plants, and

[1] *Ambrachion*, which the Greek version translates *θάμνος*, is otherwise unknown, but its meaning is clear from the context.

[2] Reading *ut* for *et*.

[3] *Magnus cannae* is ingeniously explained by Meyer. Theophr. *l.c.* has οἷον βάτος καὶ παλίουρος: the thorn-tree being unknown to the Arabs they translated παλίουρος by *moĝânas el-ʿhenna*, 'that which resembles henna (= *Lawsonia inermis*)': the Latin translator misunderstanding this expression transliterated it into *magnus cannae*.

[4] Meyer shows by comparison with the parallel passage of Theophr. *l.c.* 2, that mallow is here intended, and that *olus regium* has arisen from a confusion of two Arabic words *malûkîa* ('mallow') and *mulukijja* ('royal').

[5] *Granorum plantae*, in Arabic *habbât*, has been confused with the Arabic *chabî* ('low growing').

[6] Theophr. *l.c.* has here ἄγνος, κιττός, and ἡ Ἡρακλεωτικὴ καρύα. According to Meyer *fingekest* is the Persian for *vitex* (= ἄγνος), *vovet* is a corruption of the Arabic *fufel* (= *avellana Indica*) and *bacca caprarum* represents κιττός, 'ivy'. Ivy, however, can hardly be said to grow into a tree.

others wild, in the same way as animals. I think, too, that all species of plants which are not cultivated become wild. Some plants produce fruit, others do not; some bear flowers, others do not; some have leaves and not others; some plants shed their leaves, others do not. Plants differ greatly in their large or small size, in beauty and ugliness, and in the excellence, or the contrary, of their fruits. Trees in a wild state bear more fruit than garden trees, but the fruit of the garden tree is better than that of the wild. Some plants grow in dry places, some in the sea, others in rivers. Plants which grow in the Red Sea will there reach a great size, whereas they are only small in other places.[1]
820a Some plants grow on the banks of rivers, others in standing water. Of plants which grow in dry places, some grow on mountains, others in the plain; some plants grow and flourish in the most arid districts, as, for example, in the land of the Ethiopians which is called Ziara,[2] and increase there better than anywhere else. Some plants live at high altitudes, some on moist ground, others in dry, others equally well in either, as, for instance, willow and tamarisk. A plant changes very much with a difference of locality, and such variations must be taken into consideration.

A PLANT which is fixed in the ground does not like to be 5
separated from it. Some places are better for certain plants than others; similarly some fruits are better in one place than in another. In some plants the leaves are rough, in others smooth; in some they are small, in others they are cleft as in the vine. Some trees have a single bark, as the fig, others have several layers of bark, as in the case of the pine; some are bark throughout, as, for example, the mediannus.[3] Some plants have joints, reeds, for example; some have thorns, like the bramble. Some have no branches, others have a great number, like the sycamore.[4] Other plants show various differences; for instance, suckers grow from some and not from others; this can only be due to a difference in the root. Some plants[5] have a single root

[1] This statement is borne out by Strabo, p. 383 and Theophr. *op. cit.* I. 4.
[2] Meyer thinks that the Sahara is meant here.
[3] This word is hopelessly corrupt.
[4] '*Morum silvestrem* pro *sycomoro*' (Meyer).
[5] i.e. bulbs.

only, the squill for example; for it grows in a single shoot and spreads by expansion underground, and will increase as it grows more and more and approaches the sunlight, because the sun draws out its scales.

Of the juices which are found in fruits, some are drinkable, as, for instance, the juice of grapes, pomegranates, mulberries, and myrtles. Some juices are oily, as in the olive and pine-nut; others are sweet like honey, as in the date and fig; others are hot and pungent, as in marjoram and mustard; others bitter, as in wormwood and centaury. Some fruits are made up of a fleshy and a bony substance and a seed, plums for example; others, cucumbers for instance, are made up of a fleshy substance and seeds, others of moisture and seeds like the pomegranate. Some have rind outside and seed inside, others flesh outside and seed inside; in others one comes immediately upon the seed **820b**
with the envelope which encloses it, as in dates and almonds; in others this is not so. Fruits are edible or inedible accidentally, and some people can eat certain fruits while others cannot, and certain animals can eat certain fruits while others cannot. Some fruits, again, are in pods, like seeds; others in sheaths, like weapons, wheat for example; others are enclosed in a fleshy substance, dates for instance; others in husks,[1] acorns for example, and some in several husks, a cuticle[2] and a shell, walnuts[3] for example. Some fruits mature quickly, like mulberries and cherries, others slowly, as do all or most wild fruits. Some plants produce their leaves and fruits quickly, others slowly; some wait for the winter before coming to maturity. The colours of fruits and flowers vary very much. One plant is green throughout, another has a tendency to blackness, another to whiteness, another to redness. Also the conformation of the fruit, if it be wild, varies considerably; for all fruits are not angular, nor do they take the form of straight lines.

6 In aromatic trees it is sometimes the root which is aromatic, sometimes the bark, sometimes the flower, and

[1] *Cafta*, a transliteration of the Arabic *geft* (Meyer).
[2] '*Telam* dixisse videtur *cuticulam seminis propriam*' (Meyer).
[3] '*Nux juglans* est' (Meyer).

sometimes the wood; in other cases every part is aromatic, in the balsam for example.

Some trees come into existence by being planted, some from seeds, others spontaneously. Those which are planted are separated either from the root, the stem, the branches, or the seed, or else the whole is transplanted; some are slightly bruised before being planted. Some are planted in the earth, others are planted, that is, grafted, on other trees. Grafting of one on another is better in the case of trees which are similar and have the same proportions; the best results are obtained in the grafting, for instance, of apple on pear, fig on fig, or vine on vine. Sometimes grafting of different species is resorted to, bay,[1] for example, on wild plane,[2] olive-trees on terebinth,[3] mulberries on a number
821a of different trees, and wild trees on garden trees. Every plant does not produce a seed similar to that from which it is sprung; some produce a better seed, others a worse, and good trees sometimes grow from bad seeds, as in the case of bitter almonds and pomegranates. In some trees too, when they are weak, the seed fails, in the pine for example, and the palm. But a good plant is not likely to be produced from a bad seed, nor a bad tree from a good seed. Instances, however, of good producing bad and *vice versa* often occur among animals.

A tree which has hard bark and has become barren, if its root be split and a stone inserted in the cleft will become fruitful again. In palms too, if the leaves or pollen or bark of the male palm be applied to the leaves of the female palm so as to cohere, its fruits will come to maturity quickly, and it will prevent their falling off. The male can be distinguished from the female palm, because it sprouts first and its leaves are small, and also because of its odour; sometimes all these conditions are present, sometimes only some of them. It will perhaps happen that the wind will bear the odour of the male to the female palm, and then the dates will come to maturity; the foliage of the male will also cohere to that of the female palm when

[1] *Artemisia*, probably the Arabic *al-damasit* (= *laurus*) (Meyer).
[2] *Adul*, probably the Arabic *ad-dulb* (= *platanus*) (Meyer).
[3] *Botam*, probably the Arabic *botham* (= *terebinthus*) (Meyer).

they catch in one another. Wild fig-trees, too, spread along the ground and are attracted by garden fig-trees; similarly wild olives are attracted by olives, when they are planted together.

7 Again, some plants change into other species, the nut-tree, for example, when it becomes old. It is also said that catmint changes into mint, and basil, if plucked up and planted by the Persian Gulf, will perhaps turn into thyme. Also wheat and flax change into tares.[1] The poisonous nightshade[2] which grows in Persia changes its nature if transplanted into Egypt and Syria and becomes edible. Almond-trees and pomegranates change their condition for the better under cultivation. Pomegranates are improved by being manured with pigs' dung and watered with fresh cold water. Almond-trees with pegs driven into them exude gum for a long while. Many wild plants are thus artificially changed into garden plants. Position and care, 821b
and, above all, the season of planting, contribute to this process. Some plants require some one to plant them, others do not. Most plants are planted in the spring, a few in the winter and autumn, very few in the summer after the rising of the dogstar; planting at this season takes place in few places—nowhere except in the Crimea.[3] In Egypt planting only takes place once in the year.

Some trees produce shoots[4] from their roots, some from their buds, some from the wood, others from every part. In some they are near the ground, in others far from it, in others they are neither high nor low: others produce a few shoots at various times. Some trees bear fruit once a year, others several times, and their fruit does not mature, but remains unripe. Certain trees are very fruitful over a long period, as, for instance, fig-trees. Some bear fruit one year and then recuperate for a year, as do olive-trees, although they produce a number of boughs which cover them. Some trees are more productive when

[1] *Seilam*, Arabic *schailam* = *lolium* (Meyer).

[2] Or perhaps 'henbane' (Meyer).

[3] These words are certainly corrupt. Meyer thinks that *Coruma* is the Arabic *Qirm*, 'the Crimea'.

[4] '*Folia* errore quodam dictum pro *germina* (βλαστήματα)' (Meyer).

they are young than when they are old; others, on the contrary, are more fertile when they are old, almond-trees, for example, and pear-trees and holm-oaks. Wild and garden plants can be distinguished by identification with the male and female, each being recognizable by its peculiar characteristics; for the male is thicker and harder and has more branches and less moisture and a smaller fruit, and does not reach such maturity; the leaves, too, and likewise the twigs, are different.[1]

After these considerations we ought to form some conclusions in order that we may know trees and their various kinds apart, and similarly in the case of small herbs. We must consider what the ancients have said on these points, and examine the works written upon them. We shall only be able to take a brief survey and extract the essence of them. This means that we shall consider those plants which contain oil, those which produce seeds, and those which produce wine, and plants which have medicinal properties, and those which destroy life. All these particulars about trees and plants are well known. But in order to know their causes, we ought to inquire into their production, and discover why certain plants grow in certain places and not in others, and at certain seasons and not at others; we must examine their methods of planting, their roots, their differences of sap and odour and juice and gum,
822a and the excellence and defects of particular plants, and the fact that the fruits of some trees last but not those of others, and why some fruits putrefy quickly, others more slowly. We must inquire into the properties of all plants, and particularly those of their roots; and why some fruits grow soft while others do not; and why some affect the bowels, others cause sleep, and others are fatal to life; and many other differences.

[1] Theophr. *op. cit.* III. 2, 3 distinguishes in almost similar terms between wild and garden plants: our author seems here to go a step further and make the wild plant akin to the male and the cultivated to the female plant. In this passage he gives only the characteristics of the male plant; those of both are given in 817a 6–9.

BOOK II

I A PLANT has three powers, the first derived from the element of earth, the second from that of water, the third from that of fire. From the earth the plant derives its solidity, from water the unity, and from fire the concretion of its solidity. We see much the same thing in vessels of pottery, which contain three elements—clay, which is, as it were, the material of pottery; secondly, water, which binds the pottery together; and, thirdly, fire, which draws its parts together, until it completes the process of manufacture. The appearance, then, of complete unity is due to the fire; because rarity is present in pottery according to the composition of its parts, and, when the fire heats them, the moist matter is solidified,[1] and the parts of the clay will cohere together. Dryness will thus take the place of moisture, owing to the predominance of the fire and the process of concoction[2] which takes place in all animals, plants, and metals. For concoction takes place where moisture and heat are present, when the struggle between them is allowed to run its course; and this is what will take place in the concoction of stone and metals.[3] It is not so in animals and plants; for their parts are not closely compacted, and so there is an escape of moisture from them. But in metals there is no such escape of moisture or sweating, because their parts have no rarity, and therefore they can give up nothing except parts of themselves to correspond to certain superfluities which are given off by animals and plants. This escape of moisture can only take place where rarity is present; and so where there is no rarity, nothing at all can be given off. Therefore that which cannot be increased is solid, because that which might increase lacks space in which to dilate and grow; and therefore stones, salt, and earth are always the same,

[1] Reading *firmatur* for *firmetur*.
[2] The Aristotelian process of πέψις.
[3] i. e. in minerals the moisture is finally expelled by the heat.

neither increasing nor growing. There is motion in plants in a secondary sense,[1] and this is a form of attraction, namely, the force of the earthly element[2] which attracts moisture; in this attraction there will be motion, and the moisture makes for a certain position, and the process of concoction is thus in a certain way completed. And so small plants usually come into being in the short space of a single day,[3] unlike animals; for the nature of animals is in itself different; for no concoction will take place except by the use of material in the animal itself. But the material of which the plant is formed is near at hand,[4] and therefore its generation is quick, and it grows and increases, because it is rare, more quickly than if it were dense. For that which is dense lacks many powers on account of the diversity of its form and the extension of its parts in relation to one another. Consequently the generation of a plant is quicker on account of the similarity of its parts to one another,[5] and the completion of its growth is speedier. Now the parts of plants are usually rare, because the heat draws the moisture into the extremities of the plant, and the material is distributed through all its parts, and that which is superfluous will flow away; just as in a bath the heat attracts the moisture and turns it into vapour which rises, and, when it is present in superfluity, it will turn into drops of water. Similarly in animals and plants, the superfluities[6] ascend from the lower into the upper parts and then descend in their action from the upper to the lower parts.

We find the same phenomenon in streams which are generated underground and come forth from mountains, and whose material is rain. When the waters increase and are confined within the earth, an excess of vapour will be produced from them on account of their compression underground, and the vapour will break its way through the earth and fountains and streams will appear, which were formerly hidden.

[1] Cf. *Phys.* 243a 6 ff.

[2] *Vis terrae*, i.e. the force of the element of earth present in the plant.

[3] Cf. *G. A.* 762a 18–21.

[4] Cf. *P. A.* 650a 20.

[5] Reading *alteram* (sc. *partem*).

[6] i.e. the excess of nutritive fluid.

2 We have set forth the causes which produce springs and rivers in the book on Meteorology.[1] An earthquake frequently discloses springs and rivers which had not before been visible, when the earth is rent by vapour. We also often find that springs and rivers are submerged when an earthquake takes place. But this does not happen in the case of plants, because air is present in the rarity of their 823a
parts. This can be illustrated by the fact that an earthquake never takes place in sandy localities, but only where the ground is hard, that is in districts of water and mountains. Earthquakes occur similarly in these districts, because water and stone have no rarity in them,[2] and it is the nature of warm, dry air to ascend. When, therefore, the particles of air become massed together, they gain force and thrust up the ground and the vapour makes its way out; whereas, if the ground were rare,[3] the vapour would make its way out gradually from the first. But the ground being solid, it does not make its way out gradually, but its parts collect, and it is then strong enough to rend the earth. This, then, is the cause of earthquakes in solid bodies; there will, therefore, be nothing to correspond to an earthquake in the parts of plants and animals, though it will occur in other things—often, for example, in pottery and glass, and in some cases in minerals. Any body which has considerable rarity tends to rise upwards, for the air supports it. This we often see when we throw a gold coin or some other heavy substance into the water and it immediately sinks; whereas if we throw in a piece of wood, which has rarity in it, it does not sink. A gold coin sinks not because of its leaf-like form[4] nor on account of its weight, but because it is solid. That which has rarity can never altogether sink. Ebony[5] and similar substances sink because there is very little rarity in them, and therefore there will not be air present to support them; and so they

[1] Cf. *Meteor.* 349a 12 ff., 365b 1.

[2] *Solidus* here = συνεχής: water is 'solid' or 'continuous' in the sense that no rarity is present in it.

[3] As in the case of a sandy locality.

[4] *Propter folia* 'i. e. propter formam foliaceam' (Meyer); the sense, however, is not particularly good and the words are probably corrupt.

[5] Cf. *Meteor.* 384b 17.

sink, because their parts are practically solid. Oil and fat[1] always float on the surface of water. We will now give[2] the reason of this. We know that heat and moisture are present in these substances; and it is characteristic of moisture to cohere with particles of water, while it is characteristic of heat that it causes moisture to rise and makes its way towards the particles of air; and it is the habit of water to raise objects to its surface, and of air to rise upwards;[3] and water does not rise above its surface, because the whole surface of the water is one and the same, and consequently the air rises with the oil above the water. Some stones[4] too float on water, because rarity is present in them and is greater in quantity than the matter of which
823b they are formed, and consequently the space occupied by air will be greater than that occupied by the earthy element. It is the nature of water to take up a position above the earth, and of air to rise above water; the material, therefore, which composes the stone, which is of the element of earth, sinks in the water, while the element of air enclosed in the stone rises above the water. Each element therefore attracts its like in a contrary direction to the element with which it is combined. If, then, one element is equal to the other,[5] half the stone will be submerged and half will project above the surface; but if the air is present in greater quantity, the stone will float above the water. The weight of trees is made up in the same way.[6] (These stones are due to a violent collision of waves, and are originally foam which forms a white oily substance; when the wave is dashed against the sand, the sand will collect the oily foam, and the dryness of the sea will dry it up together with the superfluous salt, and the particles of sand will collect, and thus in the long process of time stones will be formed.)

[1] Meyer shows that the Arabic words *varq* (*folia*) and *vadak* (*adipes*) have here been confused.

[2] Reading *ostendemus*.

[3] *Ipsum* = *se ipsum* (Meyer).

[4] Pumice-stone, for example.

[5] The reading *mutafekia* is due to the transliteration of a misunderstood Arabic word: 'vertendum fuisset: *si ergo alter alterum adaequat, mergetur dimidius lapis*, &c.' (Meyer).

[6] i. e. wood, like pumice-stone, will float, because it has rarity in it. The rest of the chapter is a note on the formation of stones which float.

The presence of sand under the sea is explained by the fact that earth always has a fresh flavour,[1] and when water stands it will be prevented from undergoing any change,[2] and will form an enclosed mass of water in the place where it is, and the air will not draw it up ; the particles of earth, therefore, gain the upper hand and become salty, and gradually acquire heat. [3] (Now earth is found in its natural state in fresh running water, because there the water is sweet and light.)[4] And because the dryness of the earth gains the upper hand in the water, it changes it into an earthy nature, or something like it, and makes both the earth and water crisp ; and this process of drying goes on as long as the earth remains in its place and there is water still left, and it splits up the soil into small particles ; and for this reason the earth near the sea is always sandy. The same thing happens on plains which have nothing to protect them from the sun, and which are far from fresh water ; the sun has dried up the particles of fresh moisture and that which is of the nature of earth has remained ; and because the sun shines continually upon an exposed place of this kind, the parts of the soil become separated and sand is thus formed. A further proof of this is that if we dig deep down in a desert, we shall find natural soil. Natural soil, therefore, will be the basis of sand, and will only become 824a
sand accidentally and under certain circumstances, namely, when the sun's rays dwell on it for a long time and it is far removed from fresh water. The saltness of the sea is to be accounted for in a similar way ; for the basis of all water is fresh water, and saltness is accidental, occurring only under the circumstances which we have mentioned. The fact that the earth is below the sea and the sea naturally and necessarily above the earth is a self-evident proof of

[1] i.e. the earth is naturally fresh and sweet in the sense that water is 'fresh'. Three points are raised in this somewhat confused passage, (1) why does water, which is naturally fresh, become salt? (2) what changes earth, which is naturally coherent and moist, into sand? (3) why do the two changes, of fresh into salt water, and earth into sand, take place together?

[2] i.e. change into another element ; here into air.

[3] The cause of the saltness of the sea is discussed in *Meteor.* 356b ff., where the conclusion is that it is due to the heat of the earth.

[4] The words seem to be a note explaining *partes terrae*.

this.[1] Some, however, have held that the common element is that which is present in the greatest quantity,[2] and that there is a greater quantity of water in the sea than elsewhere, and that, therefore, sea-water is the element present in all water. But water naturally has its position above the earth and is lighter than it; for we have already shown that water is at a higher elevation than the earth according to the altitude at which the mass of water stands. Let us take two vessels of the same size and place fresh water in one and salt water in the other; then let us take an egg and place it in the fresh water; it will sink, whereas, if we place it in the salt water, it will float.[3] It therefore rises above the particles of salt water because these particles do not let it sink,[4] as do those of fresh water, but they can uphold the weight, which therefore does not sink. So in the Dead Sea[5] no animal can sink, nor is any animal life produced in it, because dryness predominates in it and it is like the form of earth. It is clear, therefore, that dense water finds a lower level than water which is not dense; for the dense is of the nature of earth, the rare of the nature of air; therefore, fresh water stands at a higher elevation than any other water, and is therefore further removed from earth. Now we already know that the water which is furthest removed from earth is the natural water, and we have shown that fresh water is higher in position than all other kinds of water; it therefore follows certainly and necessarily that it is the natural water. Salt water is also produced in pools, because fresh water becomes salt. The saltness, therefore, of the earth by its saltness prevails over the fresh water and the air will remain enclosed, and the mass of water will not therefore be fresh. Saltness
824b may also be produced from water by being given off from it like sweat.[6]

[1] The argument seems to be that, since we see that water is above the earth, the saltness of the sea must be due to something other than the admixture of the element of earth, otherwise the earth would sink and the water would become fresh. The sentence *quae aqua . . . elementum* is omitted, following Meyer.

[2] Cf. *Meteor.* 355b 3 ff.

[3] Cf. *Meteor.* 359a 12 ff.

[4] Reading *mergunt* with Cod. G. 1.

[5] Cf. *Meteor.* 359a 16.

[6] i.e. salt may also be produced from fresh water, just as it is given off by animals, which drink fresh water, in the form of sweat.

3 So too in the case of plants: their species will be formed, not from a simple element, but by a process of composition, just as saltness and the substance of sand are formed in[1] the water of the sea. For vapours which rise, when they become solidified, will be able to conceive these plants, and the air will descend and bedew the ground, and from it will come forth the form of their seeds through the powerful influence of the stars. But plants must necessarily have some material, and this material is water. There are, however, different kinds of water, and water only rises if it is fresh, and salt water is heavier than fresh; and so that which rises above water is rarer than water. When, therefore, the air draws it up, it will become rarefied and rise still higher; and this is why fountains and streams are formed in mountains. Similarly phlegm and blood rise to the brain, and all foods[2] also rise; so too all water rises. Even salt water rises in that part of it which heat dries out into the element of air, and, because air is always higher than water, that which rises from salt water is fresh. We shall often find the same thing taking place in baths. When heat takes hold of salt water, its parts will be rarefied, and vapour will rise in a contrary direction to the depth of the bath, and the particles of salt and the natural moisture become separated, for the latter is of the nature of air and follows the vapour; and cloud after cloud of vapour rises upwards, and when they reach the top of the room they press upon one another. The vapour will thus collect and become condensed, and will turn into drops of fresh water dripping down, and so in salt baths the vapour will always be fresh.

Plants ought not to grow in salt water, on account of its low temperature and dryness. This means that the plant lacks two things—its proper material and a position suitable to its nature;[3] when these two conditions are present a plant will grow. Now we find that snow is the substance furthest removed from an equable temperature,

[1] Reading *in* for *ab*: 'suspicor praepositionem Arabicam hic non *ab* sed *in* vertendam fuisse' (Meyer).

[2] i.e. the nutriment supplied by food.

[3] Cf. *G. A.* 762[a] 18 ff.

and its most striking characteristic [1] is the impossibility of
825a its existing in a temperate region. We do not, therefore, find plants growing in snow; yet we often find plants appearing in the snow, and animals of all kinds, especially worms (for they are bred in the snow), and mullein and all bitter herbs. But it is not the snow which causes [2] this to be so; but a certain characteristic of snow is active. The reason is that snow falls like smoke, and the wind congeals it and the air binds it together. There is therefore rarity amongst its parts, and air will be retained in it and will grow hot, and foul water flows from it, which had before enclosed the air; and when the air is present in considerable quantities and the sun shines upon it, the air which is enclosed in the snow will burst its way out, and a foul moisture will appear and will be solidified by the heat of the sun.[3] But if the place is covered up by snow, plants will grow in it, but without leaves, because it is cut off from the equable temperature of the earth which is congenial to it. This is the reason why there are numerous flowers and leaves on small plants in places where the air and water are temperate, and few flowers and leaves on a plant which occurs in the snow. So too in very salty and dry places plants do not usually appear, because these places are far from being temperate; and the ground is impoverished, because heat and moisture, which are the characteristics of fresh water, are absent.[4] So the soil that is fresh is the mountain soil, and there plants grow quickly.

But in warm places, because there the water is fresh and the heat plentiful, the process of concoction proceeds quickly, partly as a result of the position and the air which is found there, and partly because there is a concoction of the air owing to the heat of the sun there. On mountains,[5] because they attract moisture and the clearness of the air assists the process, concoction proceeds apace; and therefore plants are generally found on mountains. In deserts

[1] *Nec in superfluo est*, i.e. 'nec abundat in ea' (Meyer).
[2] Reading *exigit* with the Basle MS.
[3] Reading *solis* for *soli*.
[4] Reading *longe*.
[5] *Montes*, a nominative absolute due to translation of the Arabic, in which such nominatives are common (cf. below 825b 19). 'Vertendum fuisset *in montibus*' (Meyer).

the saltness gains the upper hand, as we have already shown, and rarities resembling one another are left between the particles of sand; the sun has therefore no power to produce or perpetuate any continuous plant life; and so in deserts separate species of plants will not occur, but species similar to one another.

4 Plants which grow on the surface of the water will only do so when there is density in the water; the reason of this is that, when heat touches water which has no current to 825b
move it, something of the nature of a cloud comes over it and retains a little of the air, and the moisture putrefies and the heat draws it up, and it spreads over the face of the water. Such a plant has no root, because roots will only attach themselves to the hard particles of the earth, and the particles of water are loose and scattered. The heat then comes forth with the putrefaction which takes place on the surface of the water. Such a plant has no leaves because it is produced under conditions which are far from temperate, and its parts are not compact, because the parts of water are not compact. It is for this reason too that such plants grow like threads. It is because the parts of earth are compact that the plants too which grow in the earth are compact. Sometimes putrefactions are set up in damp, smoky ground, and hold the air—the sun causing them to appear when rain and winds are frequent—and the dryness of the earth will make their roots dry up and solidify, and thus fungi and mushrooms and the like will be produced. In places that are exceedingly warm,[1] because the heat assimilates[2] the water in the interior of the earth and the sun holds the heat, a vapour is formed and a plant is thus produced. This process takes place in all warm places, and the formation of the plant is thus completed. A cold locality causes a similar but contrary process; the cold air forces the heat downwards and its particles collect together, and the ground undergoes concoction with the moisture present in it; the ground is then cleft open and a plant emerges from it. Where the

[1] *Quod . . . vehementer*, another nominative absolute due to the Arabic original, cp. above, 825a 32.

[2] *Digerere* appears to be equivalent to the Aristotelian πέσσειν.

ground is fresh, water is generally not far away. When, therefore, the air which is enclosed in the earth is stirred into motion, the moisture of the water will remain behind, and the air will solidify inside the water and a plant is produced, such as the water-lily[1] and various kinds of small plants; these plants grow straight up and do not expand, because their roots are above the earth. In places too where there is warm water running, plants often grow, because the heat of the water attracts the vapours which are retained in the earth, and draws the cold moisture upwards, and air is solidified from the moisture, which it
826a assimilates owing to the heat of the water, and a plant appears, but only after a long lapse of time. Small plants too appear in sulphurous places: and when the wind blows violently upon the brimstone, it will recoil[2] back again, and the air which is in it will be stirred up, and the place will become hot, and fire will be produced from it, and will continue to be produced from it, because it exists deep down in the brimstone, which is due to impurities deposited by the air; the fire attracts the air when the sulphur putrefies, and a plant will be produced from it. Such a plant, as we have shown before, will not generally have many leaves, because it is produced under conditions which are far from equable.

Edible products will grow from plants in positions which are warm and slightly elevated,[3] especially in the third and fourth zones; fruits which fail to provide food[4] grow in cold and high districts. Many species[5] are produced in cold, high positions owing to the attraction of the moisture and the temperate conditions which prevail in the warmth of the sun on spring days. Similarly natural soil readily produces plants which are full of oil; such soil, as we have already seen,[6] is found[7] where there is fresh water.

[1] *Nenufar* = *nymphaea* (Meyer).
[2] Reading with the Basle MSS. *repercutietur*.
[3] *Lenibus altis*, 'modice altis' (Meyer).
[4] 'vertendum fuisse suspicor: *et quod eo, ut cibus fiat, non pervenit*' (Meyer).
[5] *Species* may be used here either in its ordinary sense as above, or else in its technical sense of 'plants used for medicinal purposes' as in 826 b 3.
[6] 823 b 26.
[7] '*Comprehensio eius est*, i.e. deprehenditur, invenitur' (Meyer).

5 A PLANT which grows upon solid rock takes a long time to grow; for the air which is enclosed in the stone strives to rise, and when it cannot find a way, owing to the resistance of the stone, it retreats back again and becomes heated, and attracts the residuum of the moisture in the stone upwards, and with this moisture a vapour comes forth accompanied by a resolution of small particles of the stone; and because the sun often acts upon the stone, it assists the moisture in the process of concoction, and as a result a plant is produced. Such plants do not generally grow to any height, unless they are near some soil or moisture. The growth[1] of a plant requires soil, water, and air. A rock plant will grow low,[2] and if it faces the east,[3] it will grow quickly, and slowly if it faces the west. A plant, when water is the predominant element in it, will retain the air and will not allow it to rise, and thus the plant is not nourished. Similarly, when dryness predominates, the natural heat will be diverted into the extremities of the plant and will block up the ducts through which the flow of water passed, and the plant does not receive nourishment.

6 EVERY plant of whatsoever kind needs four things (just as an animal needs four things), namely, a definite seed, a suitable position, and properly attempered water and air. When these four conditions are fulfilled, a plant will grow and increase; but if they do not harmonize, the plant will 826[b]
be correspondingly weakened. A plant which is used for medicinal purposes[4] will be more serviceable and suitable for such purposes if it grows on high mountains; its fruit, however, will be harder to assimilate and will contain less nourishment. Places which are secluded from the sun's rays will not produce much plant life (just as they will not produce much animal life), because the sun makes the day long or short according to the duration of its presence or absence,[5] and it is the sun which draws out the moisture;

[1] *Quod remanet de planta*, lit. the rest of the plant.
[2] Reading *considet* for *consideratur*.
[3] *Prope solem* = ad orientem (Meyer). [4] See note on 826[a] 14.
[5] 'Contradictio in adiecto esse videtur, quia solis recessus *dierum* longitudinem *corripit*, *noctes*que *producit*. Hic autem *producere* pro efficere, constituere, *longitudinem* pro definito temporis spatio sive longiori sive breviori dicta esse apparet' (Meyer).

and so plants which grow in sunless places will not have the strength to produce leaves and fruit. As for plants[1] which grow in watery places, when the water is still, a foulness is formed, and there will be no power in the air to rarefy the particles of water, and the air will be imprisoned inside the earth, and this will prevent the thick matter in the water from rising; then the wind will invade[2] the spot and the earth will be cleft open, and the air which is enclosed will retreat into the earth, and the wind will solidify the moisture, and from this condition of moisture marsh plants will spring. Usually such plants do not differ from one another in form on account of the constant presence of water and its thick consistency and the heat of the sun overhead. The plants which grow in damp places will appear like patches of verdure on the surface of the earth. In such a place there is, in my opinion, little rarity, and when the sun falls upon it, it will stir up the moisture and the spot will grow warm through the resulting motion and the heat which is enclosed within the earth; and so there is nothing to cause the upward growth of the plant, while the moisture helps its expansion; and so it spreads over the earth in a sheet of verdure and produces no leaves. A kind of plant also grows which appears above the surface of the water and is smaller in quantity than that just mentioned, because it is like the nature of earth, and it neither grows upwards nor expands. Often, too, one plant grows out of another plant of a different form from itself, without any root, and spreads all over the plant. For when a plant which has numerous thorns and contains an oily juice moves, its parts will open and the sun will cause its putrefactions to turn into vapour, and the putrefied place of its own accord will produce a plant, and the wind and a moderate heat assist, and the parasite grows in the form of threads and extends over the original plant. Para-
827a sitism is a peculiarity of very thorny plants, dodder and the like.

[1] A nominative absolute due to translation from the Arabic, cf. 825a 32, b19.

[2] Reading *inundabit* for *mundabit*: the Greek version has πλημμυρήσῃ.

[There is also a class of plant which has neither root nor
leaves, and another which has a stalk, but no fruit or leaves, 9–11
the tamarisk, for example.] [1]

All herbs and all things that grow above or in the earth
have their origin in one of five ways, namely, either from seed,
or from putrefaction, or from the moisture of water, or from
being planted, or from growing as parasites on other plants.
These are the five causes of plants. 5

7 Trees have three different methods of production; they
produce their fruit either before their leaves, or at the same 8
time as their leaves, or else after their leaves have grown.[2]
A plant which produces its fruit before its leaves contains 12
a considerable amount of oily juice, and when the heat
which is natural to the plant has assimilated the juice, its
maturity will quickly follow, and the juice will acquire 15
force and boil up within the branches of the plant and will
prevent the moisture from rising; the result is that the
fruit appears before the leaves. But in plants which produce
their leaves more quickly than their fruits, the effects of the
moisture are various. When the heat of the sun begins 20
to disperse the particles of water, the sun attracts the particles
of this moisture upwards, and the process of ripening
will be delayed, because the concoction of the fruit will
only take place through coagulation, and so the leaves
come before the fruit. A plant which produces its leaves
and fruit simultaneously has much moisture, and fre- 25
quently also contains an oily juice. When the heat has
assimilated the moisture, it will, as a result, rise upward,
carrying the juice with it, and the air and sun will draw it
out, and the oily juice which forms the fruit will come out,
while the moisture will produce the leaves, leaves and fruit
coming forth together. The wise men of old used to assert
that all leaves were really fruits, but so much moisture was 30
present, because the fruit did not mature or solidify owing
to the presence of heat above and the sudden attraction

[1] This sentence is transferred to this place by Meyer from ll. 9–11 below, where it makes no sense. *Jovis barba* is, according to Meyer, the Arabic *tharfa jonani*, the Greek μυρίκη, tamarisk.

[2] Transferring *est quoque . . . barba Jovis* to the end of chapter vi, and omitting *adhuc . . . operationes* with G ii.

exerted by the sun, and consequently the moisture on which the process of assimilation had had no effect changed into leaves; the leaves, they said, are simply intended to attract the moisture and serve as a protection to the fruit from the violence of the sun. The leaves ought therefore, they said, to be equally regarded as fruit. But the truth is that the moisture rises above them and the leaves are converted into real fruits,[1] as we have already said. The same theory applies
827b to olives, which often fail to produce fruit; for when nature brings about concoction of moisture, some of the thin moisture,[2] which has not matured, will rise first, and this will produce leaves and its concoction will produce flowers, and when in the second year the process of concoction is completed, the fruit will grow and will eventually use up all the available material according to the space which it has in it.

Thorns are not characteristic of plants or natural to them. My opinion is that there is rarity present in a plant, and concoction will take place at the beginning of its existence, and moisture and cold rise upwards, and they are accompanied by a slight concoction; this circulates where there is rarity, and the sun causes it to solidify, and thus the thorns will be produced. Their form is pyramidal; for they begin by being thin at the point and gradually grow thicker, because when the air is withdrawn from the plant its parts increase, as the material of which it is composed expands. The same is true of any plant or tree which is pyramidal at the top.

GREENNESS must be the most common characteristic of 8
plant life; for we see that trees are white internally and green externally. The reason is that the material which supplies their nutriment is more readily accessible: it follows therefore that there is greenness in all plants, because their material is absorbed and rarifies the wood of the tree, and the heat causes a slight concoction, and the moisture remains in the tree and appears externally: consequently there will be greenness. This is also the case

[1] *Et alterata sunt folia*, 'in veros fructus mutata sunt' (Meyer).

[2] 'thin' as opposed to the 'unctuosus humor' of which the fruit is made up.

with the leaves, unless the concoction in them is unusually powerful; and leaves are in respect of strength midway between bark[1] and wood. But greenness does not persist, nor indeed come into existence without the presence of moisture, and is of the element of earth, and is the intermediate colour between that of earth and water. This can be illustrated by the fact that when the bark of trees dries up it turns black, and the wood inside the tree becomes white, and the green, which comes between these two colours, is the colour presented by the outward appearance of the plant.

The shapes of plants fall under three classes. Some spread upwards, others downwards, while others are intermediate in height between the two. The upward extension is due to the fact that the nutritive material makes its appearance in the marrow of the plant, and the heat draws it up, and the air, which is present in the rarities of the plant, compresses it, and it assumes a pyramidal form, just as fire assumes a pyramidal form in bodies in which it is present and rises upwards. Downward extension is due to the blocking of ducts in the plant, and, when the nutritive material is assimilated, the water, which is in the marrow of the plant, will thicken, and the rarefied portion proceeds on its upward course, while the water returns 828a
to its former position in the lower portion of the plant, and by its weight presses the plant downwards. In the plants which are intermediate between the two classes already mentioned, the moisture is rarefied and the natural state of the plant is very nearly a temperate condition during the process of concoction, and the ducts are open through the middle of the plant, and the nutritive material spreads upwards and downwards. There is a double process of concoction; the first takes place below the plant, while the second takes place in the marrow which comes out of the earth and is in the middle of the plant; afterwards the nutritive materials make their appearance fully matured[2] and are distributed through the plant, and do not undergo

[1] *Casuram* is due to a misunderstanding of the Arabic *qaschûr* (= *cortex*).

[2] Reading *materiae maturae*, suggested by Meyer.

a third assimilation. In animals there is a third process of assimilation; this is due simply to the diversity of their limbs and to the distinctness of their parts from one another. Plants, on the other hand, are more homogeneous and repeat the same members over and over again, and the nutritive material generally has a downward tendency. The shapes of plants will depend on the character[1] of the seed, while the flower and fruit is dependent on the water and nutritive material. In all animals the first process of maturation and concoction of the nutritive liquids[2] takes place within the animal; there is no exception to this rule. But in plants the first concoction and maturation takes place in[3] the nutritive material. Every tree continues to grow up, until its growth is completed and it dies. The reason is that, while in any animal its height is much the same as its width, in a plant it is far from being so, because water and fire, the elements which compose it, rise quickly, and therefore the plant grows. Variety in the branches of a plant is due to excessive rarity, and, when the moisture is intercepted there, the process of nature will cause it to grow hot and will hasten the concoction, and thus boughs will form and leaves will appear, as we have already said.

THE shedding of leaves from trees will be due to the 9
tendency to fall, induced by quickly formed rarity. When the moisture is assimilated with the nutritive material, it will assume a pyramidal form, and therefore the ducts within will be wide and will afterwards become narrow;[4] when the nutritive material makes its appearance already assimilated and formed, it will close up the extremities of the ducts above, and the leaves will have no nutritive material, and therefore dry up. When the contrary process

[1] Reading *qualitate*.

[2] Reading *positus humorum motus* (the Basle MS. has *positus humor motus*). In animals the first concoction of the nutritive matter takes place in the animal; in plants it takes place in the earth before the nutritive matter is absorbed, cp. *P. A.* 650^a 20.

[3] Meyer shows that the Arabic preposition should have been rendered by *apud* rather than *secundum*.

[4] Omitting *et pyramidabuntur* with G i.

takes place, as we have said, the leaves do not fall from the trees. When coldness dominates in the plant, it will affect its colour owing to the secretion of heat in the middle of the plant and the presence of cold outside in its extremities; 828b
the result is that the leaves are blue-grey and do not fall, as in the olive, and myrtle, and similar trees. When trees or plants exercise a violent force of attraction, fruit will be produced once a year; when they do not exercise such a force, nature will employ the process of concoction on successive occasions and at each concoction they produce fruit, and so some plants bear fruit several times in the year. Plants which are of the nature of water bear fruit with difficulty on account of the predominance of moisture in them, and the wideness of their ducts and the tendency of their roots to fall off; when the heat is intense, the assimilation will be quick and will be rarefied owing to the water and will not solidify; this we shall find to be the case in all small herbs and in some vegetables.

A grey colour will occur where the ground is exceedingly hot; here there will be little moisture and the ducts will become narrow, and when nature wishes to bring about assimilation it will not have sufficient moisture to supply the nutritive material and the ducts will become narrow. The process of assimilation therefore will be reversed and the heat will cause it to continue, and the plant will be seen to have a colour, intermediate between white and black. When this happens it will have black wood or anything approximating to white and ebony, that is, any of the whole range of colours from that of ebony to that of elm;[1] and so such wood sinks in water because its parts are compact and the ducts in it are narrow, and no air enters into them. When white wood sinks the reason will be the narrowness of the ducts and the presence of superfluous moisture, which blocks up the ducts so that the air does not enter; consequently it sinks. Every flower is composed only of rarefied material when the assimilation first begins; and so the flower generally precedes the fruit in plants. We have already shown why it is that plants produce their

[1] Reading *ulmum*.

leaves before their fruits. In the case of plants which have slender parts the colour of the flower will resemble a bright blue; when the parts are not closely compressed, it will tend to whiteness; under medium conditions it will be a blue-grey. The absence of flowers in certain plants is usually due to the variety of their parts and their rarity or their roughness or thickness. The palm and similar trees therefore have no flowers.

829a A plant which has thick bark expands owing to the pressure of moisture and the impelling force of heat; we see this in the pine and palm. A plant which gives forth a milky juice will have such juice within it; there will be powerful heat within and an oily substance will be present there. When the heat begins to cause assimilation, the oily substance will be turned into moisture, and the heat will solidify it to a slight extent, and local warmth will be caused, and an oily liquid will be produced similar to milk, and vapour will rise from the moisture which attracts the milky substance into the extremities of the plant, and the moisture will retain the heat[1] which appears. The milky substance will not be solidified, because it is the function of heat to solidify it.[2] If the milky substance shows any considerable degree of solidification, it will be due to the presence of cold in the tree. The milky substance will solidify when it has left its original position in the tree, and the result will be the formation of gum. Gum comes out warm from the tree by distillation, and, when it comes into contact with the air, it will solidify. Some gums flow in temperate places, and these will be of the consistency of water; others flow out and solidify as hard as stone or shell. Gum which flows drop by drop keeps its form, as in the tree which is known as *aletafur*.[3] The gum which changes into a stony substance will be very cold on its first appearance, and its appearance will be caused by heat, and when it flows it will turn to stone; it will occur where the soil is very hot. Some trees undergo a change in the winter and will become sometimes green and sometimes

[1] Reading *calorem*.
[2] And, as we have just seen, the heat is retained by the moisture.
[3] According to Meyer this is *calotropis procera Rob. Brownii.*

blue-grey, and neither their leaves nor their fruits decay; for trees in which this occurs have a great quantity of heat and rarefied water in their lower reservoirs.[1] Thus as the year goes on this water will retain its heat on account of the coldness of the air; and because the heat goes out to the cold, it carries the moisture out with it, and the moisture tinctures it with the natural colour of heat, and therefore the colour is seen in the appearance of the tree. Consequently cold and heat are converted into activity, and the moisture retains heat, and therefore another colour makes its appearance.

10 FRUIT will be bitter because the heat and moisture have not completed the process of assimilation (cold and dryness hindering the completion of this process), and so fruit turns bitter. This can be illustrated by the fact that what is bitter, when put into fire, becomes sweet. Trees which grow in sour water produce sweet fruit, because the sourness 829b
assisted by the heat of the sun attracts that which is of its own quality, namely, cold and dryness. Sweet liquids therefore make their appearance inside the tree, and the innermost part of the tree becomes hot when the sun shines continuously above it, and the flavour of the fruit will be successively sour, and then, when the process of assimilation has taken place, the sourness will be gradually dissolved until it disappears, and sweetness will make its appearance. Consequently the fruit will be sweet, while the leaves and extremities of the tree will be acid. When the maturation is complete, the fruit will be bitter: this is due to a superfluity of heat with very little moisture. The moisture is used up and the fruit makes the heat rise, and so the fruit will be bitter, and the stones in the fruit will be pyramidal in form on account of the upward attraction of the heat and the downward attraction of the cold and moisture which are of the same nature as sour water; and the moisture remains in the trunk of the tree, which consequently thickens, while its extremities are thin. If trees are planted in temperate soil, they reach maturity quickly before the days

[1] *In barbis*, Arabic *in barbâs*, i.e. *in puteis* (Meyer).

of spring, because, when the heat is almost temperate and the moisture has made its appearance and the air is clear, the fruit will not require much heat during the process of assimilation. Consequently maturity comes quickly and takes place before the days of spring. Bitterness or harshness of flavour is prevalent in all trees when they are first planted. The reason is that when the moisture is in their extremities and has caused assimilation in the parts that are in the middle of the tree, from which the material of the fruit comes, the dryness comes forth and follows the moisture, and the first assimilation will be sour or bitter or harsh. The reason is that the assimilation takes place in the heat and moisture, and when moisture or dryness prevails over the heat, the fruit so produced will not at first have undergone complete assimilation, and consequently the production of fruit is at first without sweetness.

Bennut-trees[1] at first when the fruit appears are sweet, and subsequently become harsh in flavour and finally bitter. The reason of this is that the tree has excessive rarity in it, and at the time of assimilation, when the ducts are wide, the heat will follow the moisture and will cause the fruit to mature; consequently the fruit will be sweet at first. Subsequently the heat attracts the dryness which resembles its own nature, and will cause the ducts to contract, and cold and dryness will prevail over heat and moisture; the fruit, therefore, will change to a harsh flavour. Next, the
830a sun with its heat will prevail through the attraction of superfluous[2] moisture in the seed, which is present at the first appearance of the tree, and the cold will prevail over the dryness; the fruit will therefore become exceedingly
830b harsh in flavour. Next, the natural heat will rise upwards, and the heat of the sun outside will assist it; therefore the heat and dryness will prevail, and the fruit will become bitter.

Here ends the book on Plants.

[1] Meyer thinks that the Greek original probably had στρύχνοι ὑπνωτικοί, which was translated by the Arabic *balân*, which the Latin translated by *myrobalani*.

[2] Reading *superfluae*.

DE MIRABILIBUS AUSCULTATIONIBUS

BY

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PREFACE

In the following translation I have followed in the main the text of Apelt (Teubner, 1898) which rests on the recension of Bekker, while the Laurentian MS. (S^a) is closely followed, with a few exceptions. Very different from this is the text of Beckmann (Gottingen, 1786); but his learned notes have been useful. I must acknowledge my obligations also to the Latin version in Bussemaker's edition (Didot, 1878), and to the German rendering of Schnitzer (Stuttgart, 1860). My thanks are due to Mr. Kenyon of the British Museum for kindly transcribing for me Hermann's emendation (ch. 133) before Apelt's edition came to my hand. Many valuable suggestions are due to the kindness of Mr. W. D. Ross, Fellow of Oriel College, Oxford.

L. D. D.

Hove.
June 30, 1909.

The *De Mirabilibus Auscultationibus*, though undoubtedly not written by Aristotle, has been included in this series from a wish to omit, as nearly as possible, no part of the *corpus* associated with Aristotle's name and printed in the standard editions of his works. Much of the book is at least of Peripatetic origin.

W. D. R.

Oxford.
October 21, 1909.

DE MIRABILIBUS AUSCULTATIONIBUS

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DE MIRABILIBUS AUSCULTATIONIBUS

1 Men say that in Paeonia, on the mountain called Hesaenus, which forms the boundary between the Paeonian and Maedian[1] districts, there is found a wild beast, which is called Bolinthos,[2] but by the Paeonians is named Monaepos. They state that this in its general nature is similar to the ox, but surpasses it in size and strength, and moreover is distinguished from it by its mane; for like the horse it has a mane hanging down very thick from the neck, and from the crown of the head as far as the eyes. It has horns, not such as oxen have, but bent downwards, the tip being low down near the ears; and these severally contain more than three pints, and are very black, and shine as though they were peeled;[3] and when the hide is stripped off it occupies a space capable of containing eight couches. When the animal is struck with a weapon it flees, and only stops when it is quite exhausted. Its flesh has an agreeable taste. It defends itself by kicking, and voiding excrement over a distance of about twenty-four feet. It easily and frequently employs this kind of defence, and the excretion burns so severely that the hair of the dogs is scraped off. They say, however, that the excrement produces this effect only when the animal is disturbed, but when it is undisturbed it does not burn. When they bring forth young, assembling in larger numbers and being all gathered closely together, the full-grown ones bring forth, and void excrement as a defence round their young; for the animal discharges a large quantity of this excretion. 830a

2 In Arabia aiunt camelos non inire matres suas; sed etiamsi quis cogat, nolunt; namque curatorem admissario aliquando destitutum operto[4] matrem submisisse ferunt pullo. Is[5] vero coitum tunc quidem, ut videtur, absolvit; paulo tamen post armentarium morsibus necavit. 830b

[1] *μηδικήν* MSS. Sylburg corrects to *Μαιδικήν*. Cf. c. 115.
[2] Bison, or wild ox, probably the same as the Bonasos.
[3] Gesner conj. *λελιπασμένα*. Cf. *Hist. An.* ix. 45.
[4] *al.* opertam. Cf. *Hist. An.* ix. 47; Ovid, *Met.* x. 324.

3 Men say that the cuckoos in Helice, when about to breed, do not build a nest, but lay their eggs in the nests of ring-doves or turtle-doves, and neither sit on their eggs, nor hatch them, nor rear their young; but when the chick is born and reared, it expels its companions from the nest. Moreover, it appears, it grows large and beautiful, so that it easily overcomes the rest. They say that the ring-doves also take such a delight in it that they even assist it to drive out their own young.

4 The she-goats in Crete, when they are shot with arrows, seek, it would appear, for the dittany, which grows there; for as soon as they have eaten it, they straightway expel the arrows from their bodies.

5 Men say that some of the stags in Achaea, when they have shed their horns, proceed to places of such a kind that 831a they cannot be easily found; and that they act in this way because they have no means of defence, and also because the parts from which they have shed their horns give them pain; and it is stated that, in the case of many of these animals, ivy is seen growing in the place of the horns.

6 Men say that in Armenia a certain poison grows, which is called leopard's bane. So, when a leopard is seen, they anoint a victim with this, and let it go. When the leopard touches it, she goes, it would appear, in quest of human excrement. Therefore the hunters put it in a vessel, and suspend it from a tree, so that the leopard, by leaping up towards it and becoming exhausted, may be paralysed by it, and fall into their power.

7 Men say that in Egypt the sandpipers fly into the mouths of the crocodiles, and cleanse their teeth, pulling out the pieces of flesh, which stick in their snouts, while the crocodiles are pleased, and do them no harm.

8 Men say that the hedgehogs in Byzantium perceive when north or south winds are blowing, and immediately change their holes; and, when the winds are southerly, make their holes opening out of the ground, but, when they are northerly, out of the walls.

9 The she-goats in Cephallenia do not drink, as it appears, like other quadrupeds; but daily turning their faces towards the sea, open their mouths, and take in the breezes.

10 In Syria inquiunt inter silvestres asinos[1] unum praeire armento, atque si iunior aliquis pullus feminam conscenderit, ducem indignari, et hunc tantisper persequi, dum comprehendat ac in crura posteriora conquiniscens ore verenda evellat.

11 Men say that tortoises, when they have eaten part of a viper, eat marjoram as an antidote, and, if the creature fails to find it at once, it dies; that many of the country-folk, wishing to prove whether this is true, whenever they see it acting in this manner, pluck up the marjoram, and when they have done so, the tortoise is presently seen dying.

12 Viverrae aiunt genitalia esse reliquorum animalium na- 831b
turae absimilia, dum ipsis, quomodocumque demum affectis, semper sint instar ossium solida. Singulare urinae stillicidio laborantibus remedium esse perhibent rasaque exhiberi.

13 Men say that the bird called the woodpecker climbs upon the trees like lizards, both hanging from and standing on the branches. It is further stated that it feeds upon the grubs out of the trees, and digs so deeply into the trees, in its search for the grubs, that it even brings the trees down.

14 Men say that the pelicans dig up the mussels that are found in the rivers, and swallow them; then, when they have devoured a large quantity of these, they vomit them up again, and thereupon eat the meat of the mussels, but do not touch the shells.

15 Men say that in Cyllene in Arcadia the blackbirds are born white, which happens nowhere else, and that they give utterance to various sounds, and go forth by the light of the moon; but that, if any one should attempt to capture them by day, they are caught with great difficulty.

[1] ὄνων : ἵππων Beckm.; but cf. Plin. viii. 30, Oppian, *Ven.* iii. 205.

16 It is stated by certain persons that what is called flower-honey is produced in Melos and Knidos, and that, while fragrant in smell, it lasts for only a short time; and that in it[1] bee-bread is produced.

17 In some parts of Cappadocia they say that the honey is made without a honey-comb, and that in consistency it resembles olive-oil.

18 At Trapezus in Pontus the honey gathered from the box-tree is produced, having an oppressive smell, and they say that this drives out of their senses those who are sound in mind, while it completely cures those who suffer from epilepsy.

19 Men say that in Lydia also the honey is gathered from the trees in abundance, and that the inhabitants form out of it balls without wax, and cutting off portions by very violent rubbing[2] make use of it. It is produced indeed in Thrace likewise, not so solid, but as it were of a sandy nature. They say that all honey when congealed preserves
832[a] an equal volume, not like water and all other liquids.

20 The grass of Chalcis and almonds are most useful for making honey; for they say that a very large quantity is produced by them.

21 People say that bees are stupefied by unguents, and are unable to endure the smell of them; while some say that they especially sting those who have been anointed.

22 They say that among the Illyrians those who are called Taulantians make wine out of honey. When they have squeezed out the honey-combs, they pour water on the honey, and boil it in a caldron until half is consumed; then they pour it out into earthen jars, fill them half[3] full, and lay them on boards; and on these they say it ferments for a long time, and becomes like wine, while for the rest it is sweet and strong. But now they state that this mode of preparation was adopted also among some of the inhabitants of Greece, so that the drink did not differ from

[1] Buss. reads *ὀλιγοχρόνιον δὲ κατὰ τὴν ἐ.*, omitting *ἐν τούτῳ.*

[2] Because of the hardness of the honey.

[3] *ἡμίσεα*, al. *ἥδιστα.* Probably, as Heyne thinks, these words crept into the text from a marginal gloss. Apelt conj. *πωμάσαντες* for *ποιήσαντες*, rejecting *ἡμίσεα*: cf. 845[a] 6.

old wine, and that in later times, when they inquired into the method of mixing it, they were unable to discover it.

23 They relate that in Thessaly once upon a time so large a number of serpents was bred alive that, if they had not been exterminated by the storks, the inhabitants would have left the country. Wherefore they also honour the storks, and it is unlawful to kill them, and, if any one kills them, he becomes liable to the same penalties as a homicide.

24 Likewise also it is related that there was once in Lacedaemon so great a multitude of serpents that the Lacedaemonians, owing to a scarcity of corn, used them as food; whence also they say that the Pythian priestess called them 'serpent-necked'.[1]

25 It is said that in the island of Gyaros[2] the mice eat iron.

26 Men say that among the Chalybians, in an islet situated beyond them, gold is collected by mice in large numbers: wherefore also, as it appears, they rip up those that are found in the mines.

27 It is said that travellers going from Susa to Media meet with an immense multitude of scorpions at the second stage. So the King of the Persians, whenever he was passing through the place, remained there for three days, ordering all his men to hunt them down; and he gave a prize to him who caught the greatest number.

28 Men say that in Cyrene there is not merely one sort 832b
of mice, but several kinds differing both in forms and in colours; for some are broad-faced, like mustelae,[3] and some like hedgehogs, which they call 'echines'.

29 In Cilicia they say that there is a whirlpool, in which birds, and animals besides, that have been suffocated, when immersed come to life again.

[1] Meziriac conj. ὀφιοβόρους.

[2] The MSS. read Κύπρῳ. Marsilius Cagnatus suggests Γυάρῳ (one of the Sporades) on the authority of Antigonus Caryst. c. 21, and Plin. viii. 57.

[3] The weasel is not broad-faced. It is doubtful what animal Aristotle is referring to. Cf. Bonitz's *Index*, 145b 43.

Among the Scythians who are called Geloni, they say 30
that there is a certain wild animal, excessively rare indeed, which is named Tarandos.[1] Now this is said to change the colour of its hair, according to the place in which it may be; and for this reason it is hard to catch; for it becomes in colour like to trees and places, and its surroundings generally. But the most wonderful thing is its changing its hair; for other animals change the colour of the skin, such as the chameleon and polypus. In size it resembles an ox, while the form of its face is like that of a stag.

It is said that a certain man in Abydos being deranged 31
in mind, and coming into the theatre during many days looked on (as though actors were performing a play), and applauded; and, when he was restored to his senses, he declared that that was the happiest time he had ever spent.

Moreover they say that at Tarentum a certain wine- 32
merchant was mad at night, but sold his wines during the day: he also kept the key of the cellar attached to his girdle, and though many tried to steal it from him and get possession of it, he never lost it.

In the island of Tenos they say there is a small bowl 33
containing a mixture, from which people kindle fire very readily. Moreover in the Thracian Bithynia[2] there is found in the mines the stone which is called 'spinos',[3] from which they say that fire is kindled.

People say that in the island of Lipara there is a certain[4] 34
place where the air is sucked down into the earth, and that if they bury a pot there they can put therein whatever they please and boil it.

833a Both in Media and in Psittacene, a district of Persia, 35
there are fires burning, that in Media small, but that in Psittacene large and with a bright flame; for which reason also the King of the Persians constructed kitchens near it.

[1] Elk, or reindeer. [2] Sithonia? (conj. Sylburg). [3] Alum-slate?.
[4] Reading with Apelt τινα εἰσπνοήν instead of vulg. τινες γῆν. This local use of εἰσπνοή is peculiar.

Both these are in level, not in elevated places. These fires are conspicuous both by night and by day, while those in Pamphylia are seen only at night.

36 They say also that at Atitania, near the borders of the district of Apollonia, there is a certain rock, and fire rising from it is not visible, but whenever oil is poured thereon blazes up.

37 It is said that the places outside the Pillars of Hercules burn, some constantly, others at night only, as Hanno's *Circumnavigation* relates. The fire also in Lipara is visible and flaming, yet not by day, but only at night. They say also that in Pithecusae the ground is fiery, and extraordinarily hot, yet not burning.

38 Xenophanes states that the fire in Lipara once failed for sixteen years, but returned in the seventeenth year. They say that the lava-stream in Etna is neither flaming nor continuous, but returns only after an interval of many years.

39 It is said that in Lydia a vast amount of fire blazed up, and continued burning for seven days.

40 The lava-stream in Sicily is an extraordinary phenomenon. The breadth of the fire that blazes up amounts to forty stadia, while the height to which it is carried amounts to three.

41 They say that the stone in Thrace which is called 'spinos' burns when split in two, and that it also, like charcoal-embers, when put together again, and sprinkled with water, burns; and that the stone called 'marieus[1]' does the same.

42 At Philippi in Macedonia they state that there are mines, the refuse from which, they say, increases and produces gold, and that this is an observable fact.

[1] Cod. Vind., with two other MSS., has *μαριθάν*, for which Salmasius suggests *νάφθαν*. Sylburg suggests *θρᾳκίαν*, the Thracian stone being mentioned in c. 115. Cf. Alexandri *Problemata*, p. 322 *λίθος θρᾳκίας, ὕδατι μὲν καιόμενος, ἐλαίῳ δὲ σβεννύμενος.*

They say that in Cyprus, at the place called Tyrrhias,[1] 43
copper is produced in like manner; for men having cut it up, as it appears, into small pieces, sow it, and then, when the rains have come on, it grows and springs up, and so is collected.

They say that in the island of Melos, in those parts of 44
the ground that are dug up, the earth fills itself up again.

In Paeonia they state that when continuous showers have 45
fallen, and the ground is thoroughly soaked, there is found what is called gold without fire.[2] They state, too, that in Paeonia the ground is so rich in gold that many persons have found gold even exceeding a pound in weight. And they say that certain persons, who had found them, brought two nuggets to the king, one weighing three pounds, the other five; and they say that these are set beside him on the table, and, if he eats anything, he first offers a libation upon them.

They say that among the Bactrians also the river Oxus 46
carries down numerous small nuggets of gold, and moreover that in Iberia the river called Theodorus[3] both throws out much gold on its banks, and likewise also carries it down the stream.

They state also that in Pieria, a district of Macedonia, 47
some uncoined gold was buried by the ancient kings, and, while there were four cavities, from one of them gold grew up a span in length.

It is said that the production of the Chalybian and 48
Amisenian[4] iron is very peculiar; for it grows together, as at least they assert, from the sand that is carried down by the rivers. Some say that they simply wash this, and smelt it in a furnace; but others that, after frequently washing the deposit left by the first washing, they burn it, and insert what is called the fire-proof stone which is abundant in the country. This iron is far more beautiful than the other kinds. But if it were not burnt in the furnace it

[1] Meursius conj. τὸ λεγ. Κούριον. Cf. Strabo, xiv. p. 683.
[2] i.e. unsmelted, solid.
[3] Identified with the Durius, mod. Douro. Cf. Rose, *Arist. frag.*, p. 206 (Teubner). Beckm. conj. Θερμωδῶν (in Cappadocia).
[4] Amisus was a town in Pontus, mod. Eski Samsun. Rose conj. ἀσήμου.

would not at all differ, as it appears, from silver. Now they say that it alone is not liable to rust, but that it is not very plentiful.

49 They say also that among the Indians the copper is so bright, pure, and free from rust that it cannot be distinguished in colour from gold; moreover that among the cups of Darius there are certain goblets, and these not inconsiderable in number, as to which, except by their smell, one could not otherwise decide whether they are of copper or gold.

50 They say that the Celtic tin melts much more quickly than lead. A proof of its fusibility is that it is believed to melt even in water: at any rate, it seems, it stains quickly. Now it melts in the cold[1] also, when the weather is frosty, because, as they say, the hot substance inherent in it is by reason of its weakness shut up and compressed within.

51 In the Pantheon[2] there is an olive-tree, which is called that 'of the beautiful crowns'. But all its leaves are contrary in appearance to those of other olive-trees; for it[3] has the pale-green outside, instead of inside, and it sends forth branches, like those of the myrtle, suitable for crowns. From this Heracles took a shoot, and planted it at Olympia, and from it are taken the crowns which are given to the combatants. This tree is near the river Ilissus, sixty[4] stadia distant from the river. It is surrounded by a wall, and a severe penalty is imposed on any one who touches it. From this the Eleians took the shoot, and planted it in Olympia, and from it they took the crowns which they bestowed.

52 In the Lydian mines near Pergamos, which also Croesus had worked, the following incident occurred. When a certain war arose the workmen fled to them; but, as the mouth was built up, they were suffocated; and a long time afterwards, when the mines were cleared out, vessels, which they used to employ for daily uses, such as jars

[1] Beckm. conj. *ψήγμασιν*. [2] At Athens.

[3] Kuster reads *ἔξω γὰρ οὐκ, ἀλλ' ἐντός*. But the schol. explains *χλωρά* by *λευκά*.

[4] Perhaps 'six' should be read, as $\xi' = 60$ might easily arise from *ἕξ*. Schol. Theocr. iv. 7 says *ὀκτώ*.

and the like, were found petrified. These, being filled with whatever liquid it might be, had been turned to stone, as well as the bones of the men.

In the Ascanian lake the water is so impregnated with soda that garments have need of no other cleansing substance; if one leaves them too long in the water they fall to pieces. 53

Near the Ascanian lake is Pythopolis, a village about one hundred and twenty stadia distant from Cius, in which 54
834b all the wells are dried up in the winter, so that one cannot dip a pitcher into them; but in the summer they are filled up to the brim.

The strait between Sicily and Italy increases and diminishes along with the changes of the moon. 55

It is stated also that on the road to Syracuse there is in a meadow a spring, neither large nor containing much water; but, when once a great crowd met at the place, it supplied water in abundance. 56

There is also a certain spring in Palici[1] in Sicily, about as large as the space ten couches would occupy. This throws up water to the height of six cubits, so that it is thought by those who see it that the plain will be inundated; and again it returns to its original state. There is also a form of oath, which is considered to be sacred there; whatever oaths a man swears he writes on a little tablet, and throws into the water. If therefore he swears truly, the tablet floats on the top; but if he swears falsely, they say that the tablet grows heavy and disappears, while the man is burnt. Wherefore the priest takes security from him that some one shall purify the temple. 57

Demonesus, the island of the Chalcedonians, received its name from Demonesus, who first cultivated it. The place contains the mine of cyanos and gold-solder. Of this latter the finest sort is worth its weight in gold, for it is also a remedy for the eyes. In the same place there 58

[1] It was called *ἡ τῶν Παλικῶν λίμνη*, mod. Lago di Naftia. We should have expected *ἐν Παλικῇ*, as the Palici were twin sons of Zeus and Thalia, whose temple stood near a volcanic lake, in which two jets of gas throw up the water to a great height, and hence became sacred to the two indigenous deities, called Palici *διὰ τὸ ἀποθανόντας πάλιν εἰς ἀνθρώπους ἱκέσθαι*. Cf. Sotion, 8. Steph. Byzant. Παλική.

is also copper, obtained by divers, two fathoms below the surface of the sea, from which was made the statue in Sicyon in the ancient temple of Apollo, and in Pheneus the so-called statues of mountain-copper. On these is the inscription—'Heracles, son of Amphitryon, having captured Elis, dedicated them'. Now he captured Elis guided, in accordance with an oracle, by a woman, whose father, Augeas, he had slain. Those who dig the copper become very sharp-sighted, and those who have no eyelashes grow them: wherefore also physicians use the flower of copper[1] and Phrygian ashes for the eyes.

59 Now in the same place there is a cave which is called the pretty[2] cave. In this pillars have been formed by congelation from certain drippings of water: and this becomes evident from their being contracted[3] towards the ground, for the narrowest[4] part is there.[5]

60 Of the offspring of a pair of eagles, so long as they pair together, every second one is a sea-eagle. Now from the 835a sea-eagles springs an osprey, and from these black eagles and vultures: yet these on the other hand do not bring the breed of vultures to a close, but produce the great vultures, and these are barren. And a proof is this, that no one has ever seen a nest of a great vulture.

61 A wonderful thing they say happens among the Indians with regard to the lead there; for when it has been melted and poured into cold water it jumps out of the water.

62 Men say that the copper of the Mossynoeci is very brilliant and white, no tin being mixed with it; but there is a kind of earth there, which is smelted with it.[6] They state that the man who discovered the mixture did not inform any one; so the copper vessels formerly produced in these parts were excellent, but those subsequently made were no longer so.

63 Men state that in Pontus some birds during the winter

[1] Capillary red copper-ore.

[2] Or hollowed: cf. Hom. *Od.* ix. 114 *ἐν σπέεσσι γλαφυροῖσι.*

[3] Weise reads *ἀναγώγῃ.*

[4] Weise *στεγνότατον.*

[5] *εἰσὶ . . . στενώταται* has been suggested.

[6] This seems to have been cadmia, and the mixture what is called Prince Rupert's metal, or white copper. The Mossynoeci lived on the southern shores of the Black Sea, and derived their name from the wooden towers (*μόσσυν*) in which they dwelt. Cf. Xen. *Anab.* v. 4. 26.

are found lurking in holes, and not[1] discharging excrement, and when people pluck out their feathers they do not feel it, nor yet when they are pierced on a spit, but only when they have been burnt through with fire. They say that many fishes also, when trimmed and cut round, have no perception of it, but only when they have been warmed through by fire.

The bee is thought to announce the solstices by going 64
to its labours, which the bee-keepers also use as a sign, for then they have rest. The grasshoppers also appear to chirp only after the solstices.

They say also that the hedgehog continues without food 65
for a year.

It is said that the spotted lizard, when it has stripped 66
off its slough, like snakes, turns round and swallows it, because physicians look out for it, from its being serviceable to those who suffer from epilepsy.

Men state also that the fat of the bear, when it has 67
been congealed owing to the winter, increases as long as the bear lies hidden in its den, and overflows the vessels in which it is kept.

They say that the frogs in Cyrene are altogether dumb, 68
and that in Macedonia, in the country of the Emathiotae, the swine have solid hoofs.

835b They say that in Cappadocia there are mules possessed 69
of generative powers, and in Crete black poplars which yield fruit.

They say also that in Seriphos the frogs do not croak ; 70
but if they are transferred to another place they croak.

Among the Indians, in what is called the Horn, it is 71
stated that there are little fishes, which wander about on the dry land, and run away again into the river.

Some say also that in the neighbourhood of Babylon 72
certain fishes remain in the holes, which contain moisture, while the river is drying up; that they go out to the threshing-floors and feed, and walk upon their fins, and

[1] Read *οὐδὲ ἀφοδεύοντα.*

move the tail to and fro, and when they are pursued they flee, enter into their holes, and stand facing their pursuer; for people often approach and tease them. Their head is like that of the sea-frog, while the rest of the body resembles that of the gudgeon, and they have gills like other fishes.

73 At Heraclea in Pontus, and in Rhegium, they say there are fish obtained by digging, especially in places near rivers, and such as are well watered; and that it sometimes happens that when these places dry up at certain seasons, the fish shrink under the earth, and then when this dries up still more, they, in search of humidity, enter into the mud; then when this becomes dry, they remain in the moisture, like animals which continue in their holes; but, when they are dug up before the waters come on, they then move.

74 They say also that in Paphlagonia the fish obtained by digging are met with deep in the ground, and that these are of an excellent quality, though neither is water to be seen close at hand, nor do rivers flow into the place; the earth engenders them of itself.

75 Men say that the stags in Epirus bury their right horn, when they have shed it, and that this is useful for many purposes.

76 They say that the lynx too covers up its urine, because of its being useful for signet-rings as well as for other things.

77 They also state that the sea-calf, when taken, vomits out rennet, and that this is medicinal and serviceable to those who suffer from epilepsy.

78 It is said that on the Circaean mountain in Italy there grows a deadly poison, which is so potent that, if it be 836a
sprinkled on any one, it straightway causes him to fall, and the hairs of his body to drop off, and generally the limbs of his body to waste away, so that the surface of the body of those who are dying is a pitiable sight. They say too that Aulus the Peucestian and Gaius were detected when about to administer this poison to Cleonymus

the Spartan, and that having been examined they were put to death by the Tarentines.

In the island of Diomedeia, which lies in the Adriatic, 79
they say there is a temple of Diomedes, wonderful and holy, and round the temple there sit in a circle birds of a large size, having great hard beaks. These birds, they state, if Greeks land at the place, keep quiet; but if any of the barbarians who live around them approach, they fly up, and soaring in the air swoop down upon their heads, and, wounding them with their beaks, kill them. The story goes that the companions of Diomedes were metamorphosed[1] into these, when they had been shipwrecked off the island and Diomedes was treacherously slain by Aeneas, who was then king of those regions.

Among the Umbrians they say that the cattle bring 80
forth young three times in the year, and that the earth yields many times more fruit than the seed that is sown: that the women also are prolific, and rarely bring forth only one child at a time, but most of them have two or three.

In the Amber islands, which are situated in the corner 81
of the Adriatic, they say that there are two statues erected, the one of tin, the other of bronze, wrought after the ancient fashion. It is stated that these are works of Daedalus, a memorial of old times, when he, fleeing before Minos from Sicily and Crete, put in to these places. But they say that the river Eridanus[2] formed these islands by alluvial deposit. Moreover, as it appears, there is near the river a lake, containing hot water, and a smell exhales from it heavy and unpleasant, and neither does any animal drink from it, nor does a bird fly over it, but falls and dies.
836b It has a circumference of two hundred stadia, a width of about ten. Now the inhabitants tell the story that Phaethon, when struck by the thunderbolt, fell into this lake; and that therein are many black poplars, from which falls what is called amber.[3] This, they say, resembles gum, and

[1] Cf. Lycophr. 594 *πικρὰν ἑταίρων ἐπτερωμένην ἰδὼν | οἰωνόμικτον μοῖραν.*
[2] Po.
[3] For the story of the tears of the Heliades being changed into amber cf. Ov. *Met.* ii. 365. So Marcianus, the geographer, describes amber

hardens like a stone, and, when collected by the inhabitants, is carried over to the Greeks. To these islands, therefore, they state that Daedalus came, and, having obtained possession of them, dedicated in one of them his own statue, and in the other that of his son Icarus; but that afterwards, when the Pelasgians, who had been expelled from Argos, sailed against them, Daedalus fled, and arrived at the island of Icarus.

82 In Sicily, in the neighbourhood of the place called Enna,[1] there is said to be a cave, round about which they assert that there not only grows a quantity of other kinds of flowers at every season of the year, but that especially an immense space is covered with violets, which fill the adjoining country with fragrance, so that the huntsmen are unable to track the hares, as their dogs are overcome by the smell. Through this chasm there is an invisible subterranean passage, by which they say Pluto carried off Proserpine. In this place it is said that wheat is found, resembling neither the native sorts, which people use, nor other kinds that are imported, but possessed of a great peculiarity. And this they use as an argument to prove that the wheat-fruit appeared first among themselves; whence also they lay claim to Demeter, affirming that the goddess was born amongst them.

83 In Crete men say that there are no wolves, bears, and vipers, and similarly no wild beasts like them, because Zeus was born therein.

84 In the sea outside the Pillars of Hercules they say that an island was discovered by the Carthaginians, desolate, having wood of every kind, and navigable rivers, and admirable for its fruits besides, but distant several days' voyage from them. But, when the Carthaginians often **837a**
came to this island because of its fertility, and some even dwelt there, the magistrates of the Carthaginians gave notice that they would punish with death those who should sail to it, and destroyed all the inhabitants, lest they should

thus—*ὅ φασιν εἶναι δάκρυον ἀπολιθούμενον | διαυγές, αἰγείρων ἀποστάλαγμά τι.*

[1] The Laurentian MS. has *ἔνναν*: vulgo *αἴτνῃ*. Instead of *περὶ τ. κ.* 'E. Weise reads *τῇ καλουμένῃ Αἴτνῃ*. So Beckm. Cf. Sil. Ital. xiv. 238 sqq.

spread a report about it, or a large number might gather together to the island in their time,[1] get possession of the authority, and destroy the prosperity of the Carthaginians.

85 From Italy as far as the country of the Celts, Celto-ligurians, and Iberians, they say there is a certain road, called the 'road of Heracles', by which whether a Greek or a native travels, he is watched by the neighbouring tribes, so that he may receive no injury; for those amongst whom the injury has been done must pay the penalty.

86 They say that among the Celts there is a poison called by them 'arrow-poison', which they assert produces corruption so quickly that the Celtic huntsmen, when they have shot a stag, or any other animal, run up to it in haste, and cut out the wounded part of the flesh, before the poison spreads, as well for the sake of the food as to prevent the animal from putrefying. They say, however, that the bark of the oak was found to be an antidote for this; but others maintain that the antidote is something different, a leaf, which they call ravenswort,[2] because a raven, which had tasted the poison, and become sick, was observed by them to hasten for this leaf, and, after devouring it, to be delivered from its pain.

87 In Iberia they say that, when the coppices were set on fire by certain shepherds, and the earth was heated by the wood, the country visibly flowed with silver; and when, after some time, earthquakes succeeded, and the ground in different places burst asunder, a large quantity of silver was collected, which brought in no ordinary revenue to the Massilians.

88 In the islands called Gymnesiae,[3] that lie off the coast of Iberia, which they assert to be the largest, after the so-called seven[4] islands, they say that oil is not produced from olives, but from the turpentine-tree in very large quantities, and adapted for every purpose. Moreover they affirm that the Iberians, who inhabit those islands, are so fond of women that they give to the merchants four or five males in exchange for one female. When they receive

[1] Reading *ἐπ' αὐτῶν*. [2] Hawkweed. [3] Balearic.

[4] i. e. Sardinia, Sicily, Cyprus, Crete, Euboea, Corsica, and Lesbos. Timaeus *ap.* Strabo, xiv. p. 967.

their pay, while serving with the Carthaginians, they purchase, it seems, nothing else but women; for no man amongst them is allowed to have gold or silver. But as a reason for their forbidding the introduction of money, some such statement as this is added, that Heracles made his expedition against Iberia for the sake of the riches of the inhabitants.

89 In the country of the Massilians, on the borders of Liguria, they say there is a certain lake, and that this boils up and overflows, and casts out so great a quantity of fish as to surpass belief. But whenever the monsoons blow the soil is heaped up upon it (such dust arises there), and its surface becomes solid like the ground, and the natives, piercing it with tridents,[1] easily take out of it as much fish as they please.

90 It is said that some of the Ligurians sling so skilfully that, when they see several birds, they contend with one another about which bird each is preparing to strike, presuming that all will easily hit their mark.

91 They say that there is also this peculiarity amongst them: the women bring forth whilst engaged in work, and after washing the child with water, they immediately dig and hoe, and attend to their other household duties, which they were obliged to perform before the time of their delivery.

92 This is also a marvel among the Ligurians: they say that there is a river[2] in their country whose stream is lifted up on high and flows along so that those on the other side cannot be seen.

93 In Etruria there is said to be a certain island named Aethaleia, in which out of a certain mine in former days copper was dug, from which they say that all the copper vessels amongst them have been wrought; that afterwards it could no longer be found: but, when a long interval of time had elapsed, from the same mine iron was produced, which the Etrurians, who inhabit the town called Populonium, use to the present day.

[1] A three-pronged fishing-spear, called in Scotland a leister.
[2] Arno. Cf. Strab. v. 340.

Now in Etruria there is a certain city called Oenarea,[1] which they say is exceedingly strong; for in the midst of it there is a lofty hill, rising upwards to the height of thirty stadia, and having at its foot wood of all sorts, and waters. 94
838a They say, therefore, that the inhabitants, fearing lest some one should become despot, set over themselves those of their slaves who had been manumitted, and these have dominion over them; but every year they appoint others of the same class in their stead.

At Cumae in Italy there is shown, it appears, a subterranean bed-chamber of the prophetic Sibyl, who, they say, was of a very great age, and had always remained a virgin, being a native of Erythrae, but by some of the inhabitants of Italy called a native of Cumae, and by some named Melancraera.[2] It is said that this place is under the sway of the Lucanians. They state moreover that in those parts about Cumae there is a certain river called Cetus,[3] and they say that whatever is thrown into this is after a considerable time first coated over, and finally turns into stone. 95

Men say that for Alcimenes, the Sybarite, a mantle was prepared of such magnificence, that it was exhibited at Lacinium during the festival of Hera, to which all the Italians assemble, and that it was admired more than all the things that were shown there. Of this they say that Dionysius the Elder obtained possession, and sold it to the Carthaginians for one hundred and twenty talents. It was of purple, fifteen cubits in width, and was adorned on either side with little figures inwoven, above with Susa, below with Persians; in the middle were Zeus, Hera, Themis, Athene, Apollo, and Aphrodite. Near each extremity was Alcimenes, and on both sides Sybaris. 96

In the neighbourhood of the Iapygian promontory, from a certain place in which, as the legends relate, the fight of Heracles with the giants took place, they say that ichor 97

[1] Steph. Byzant., who has copied these words, gives Οἶνα as the name of the city. Victorius reads Οὐλατέρρα (=Volaterra). The description in the text corresponds with Strabo's account of Volaterra, v. p. 154.

[2] Black-haired.

[3] Cod. Vind. κακέππαν (some MSS. Μακέππαν). The correction was made by a later hand. The Silarus seems meant, cp. Sil. Ital. viii. 582.

flows in great abundance, and of such a nature that, owing to the oppressiveness of the smell, the sea off that place is innavigable. They state besides that in many parts of Italy many memorials of Heracles still exist on the roads by which he travelled. Near Pandosia in Iapygia footprints of the god are shown, on which no one must tread.

98 There is also in the neighbourhood of the Iapygian promontory a stone big enough to load a waggon, which 838b
they say was lifted up by him[1] and transferred to this spot, and it was actually moved with one finger.

99 In the city of the Orchomenians in Boeotia they say that a fox was seen, which, being pursued by a dog, entered into a certain subterranean passage, and that the dog entered along with her and, barking, produced a great noise, as though he found a wide space about him; but the huntsmen, thinking there was something marvellous there, broke open the entrance, and forced their way in as well: and that, seeing the light coming in by certain holes, they had a clear view of all that was in the cave, and went and reported it to the magistrates.

100 In the island of Sardinia they say there are many beautiful buildings constructed in the ancient Greek style, and, amongst others, domes carved in remarkable proportions. It is said that these were built by Iolaus, son of Iphicles, when he, having taken with him the Thespiadae, the sons of Heracles, sailed to those parts with the intention of settling there, considering that they belonged to him through his relationship with Heracles, because Heracles was lord of all the western land. This island, as it appears, was formerly called Ichnussa, because it was shaped in its outline very similarly to a human footstep.[2] It is stated to have been previously fertile and productive; for the legend states that Aristaeus, whom they assert to have been most skilful in agriculture among the ancients, ruled over these parts, which were formerly occupied by many large birds. At the present day, however, it is no longer fertile, because when ruled by the Carthaginians it had all its fruits that were useful for food destroyed, and death was fixed as the

[1] Sc. Heracles. [2] Gr. *ἴχνος*.

penalty for the inhabitants if any one should plant again anything of the kind.

101 In one of the seven[1] so-called islands of Aeolus, which bears the name of Lipara, the legend goes that there is a tomb, about which they tell many other portentous stories, and agree in asserting that it is unsafe to approach 839a that place at night; for from it are distinctly heard the sound of drums and cymbals,[2] and laughter, along with uproar and the rattle of castanets. But they state that a still more prodigious event occurred with regard to the cave; for a certain man, under the influence of wine, fell asleep in it before daylight, and continued to be sought for by his servants for three days; but on the fourth, being found apparently dead, he was conveyed by his servants to his own tomb, and after obtaining all the usual rites, he suddenly rose up, and related all that had befallen him. This story seems to me somewhat fabulous, yet it was necessary for me not to leave it unmentioned, while giving a record of circumstances connected with that place.

102 Near Cumae in Italy there is a lake called Avernus,[3] containing in itself, as it seems, nothing wonderful; for they say that hills lie round about it not less than three stadia in height; that it is itself circular in form and of unsurpassable depth. But this is what seems marvellous: while trees stand thickly above it, and some lean over it, one cannot see a single leaf floating upon the water, while the water is so very pure that those who behold it wonder. On the mainland not far distant from it hot water springs forth from many parts, and all the place is called Pyriphlegethon.[4] But to say that no bird flies over it is a lie; for those who have been there maintain that there is a large number of swans in it.

103 They say that the Siren islands are situated in Italy at the point of the headland in the strait, which lies before the promontory[5] separating the two bays,[6] i.e. the one

[1] It may be mentioned that the Greeks to-day call the Ionian islands the Ἑπτάνησος. [2] Clemens Alex. vi. 756 (288) relates that there were similar caves in Britain and Persia, where cymbals and shouts of armies were heard, which he attributes to the winds.

[3] i.e. birdless. [4] Fire-blazing. [5] Minervae Promontorium.

[6] Reading τοὺς κόλπους with Salmasius: MSS. τοῖς κόλποις. These are S. Cumanus and S. Paestanus.

surrounding Cumae and the one which cuts off from it the city called Posidonia; on which promontory also a temple of the Sirens has been built, and they are honoured exceedingly by the neighbouring peoples with diligent sacrifices, and they, making mention of their names, call one Parthenope, another Leucosia, and the third Ligeia.

104 It is stated that between the Mentoric district and that of Istria there is a mountain named Delphium with a high crest. **839b**
When the Mentores, who dwell near the Adriatic, ascend this crest they descry, as it appears, the ships sailing into the Pontus[1]: there is also a spot, half-way between, at which when a common market is held, Lesbian, Chian, and Thasian wares are sold by the merchants coming up from the Pontus, and Corcyraean jars by the merchants from the Adriatic.

105 Men say that the Ister, flowing from what are called the Hercynian woods, divides, and in one direction flows into the Pontus, and in the other discharges its waters into the Adriatic. And we have seen a proof not only in the present times, but also more fully in antiquity, that the waters there are not[2] innavigable; for they say that Jason sailed into the Pontus by the 'Dark Rocks',[3] while he sailed out of it by the Ister; and for this, besides alleging not a few other evidences, they point out altars set up by Jason in the country, and in one of the islands in the Adriatic a costly temple of Artemis erected by Medea. Moreover they affirm that Jason could not have sailed past the 'Wandering Islands', if he were not sailing away from that quarter. And moreover in the island of Aethaleia,[4] which lies in the Tyrrhenian Sea, they point to other memorials of the chiefs of the Argonautic Expedition, and also to what is said respecting the pebbles; for they say that along the shore there are pebbles of various colours; and the Greeks who inhabit the island say that they received their colour from the oil and dirt which the heroes scraped off, while anointing themselves; for, according to the legend, neither before these times were such pebbles seen nor afterwards had any such been found. Moreover they mention still

[1] Hellespont? [2] Reading with Casaubon τοῦ τὰ ἐκεῖ ἄπλωτα μὴ εἶναι, which is supported by the Latin translation in Bekker. The manuscript reading οἷον τ. ἐ. ἀ. εἶναι seems to involve a contradiction.
[3] Symplegades. [4] Elba.

clearer proofs of this, that they[1] did not sail out through the Symplegades, citing the poet himself as a witness in the case of those regions; for (say they) he, pointing out the gravity of the danger, states that it is impossible to sail past the place[2]—

> Planks of ships and bodies of men together are carried
> By the waves of the sea and storms of fire destructive.

840a As regards the 'Dark Rocks' indeed it is not said that they send forth fire; but it happens near the strait which divides Sicily from Italy, as the eruptions of fire are found on both sides; while not only is the island continually burning, but also the stream of lava round Etna often spreads over the country.

In Tarentum they say that at certain times people offer **106**
sacrifices to the shades of the Atridae, Tydidae, Aeacidae, and Laertiadae, and besides that they celebrate a sacrifice separately to the Agamemnonidae on another special day, on which it is unlawful for the women to taste the victims offered to those heroes. There is also amongst them a temple of Achilles. Now it is said that after the Tarentines had taken it, the place which they at present inhabit was called Heraclea; but in the early times, when the Ionians were in possession, it was named Pleum[3] and at a still earlier date it was called Sigeum by the Trojans, who had gained possession of it.

Among the Sybarites Philoctetes is said to be honoured; **107**
for that on his return from Troy he founded in the Crotonian territory the town called Macalla,[4] which they say is one hundred and twenty stadia distant;[5] and historians relate that he dedicated the bow and arrows of Heracles in the temple of Apollo the sea-god:[6] but from thence they say that the Crotonians, during their dominion, took them, and dedicated them in the temple of Apollo in their own city. Now it is said that having died there[4] he lies by the river Sybaris, after he had given

[1] sc. the Argonauts. [2] *Od.* xii. 67. [3] Polieum? conj. Salmasius.

[4] Tzetzes on Lycophr. 927 states that Macalla contained the sepulchre of Philoctetes, which received divine honours from the people. No trace of the town remains. [5] i. e. from Croton.

[6] Probably we should read Ἀλαίου, i. e. releasing from wanderings. So Wesseling from Tzetzes on Lycophr. 911 *πανσθεὶς τῆς ἄλης, Ἀλαίου Ἀπόλλωνος ἱερὸν κτίζει.*

help to the Rhodians, who along with Tlepolemus had been carried out of their course to those parts, and had engaged in battle with the barbarians who inhabited that country.

108 In that part of Italy which is called Gargaria, close to Metapontium, they say there is a temple of Athene Heilenia, where they state that the tools of Epeus were dedicated, which he had prepared for the construction of the wooden horse; he having given this surname;[1] for Athene appeared to him in a dream and desired him to dedicate the tools; and he being therefore delayed in putting out to sea was cooped up[2] in the place, unable to sail out: whence the temple was called that of Athene Heilenia.

109 In the district which bears the name of Daunia, there **840b**
is said to be a temple called that of the Achaean Athene, in which bronze axes and the arms of Diomedes and his companions are dedicated. In this place they state that there are dogs which do no harm to such of the Greeks as come there, but fawn upon them, as though they were most familiar to them. Now all the Daunians and the neighbouring tribes, both men and women, wear black garments, apparently for the following reason—because it is said that the Trojan women, who had been taken captives, and had come to those parts, fearing that they might experience hard slavery at the hands of the women who already belonged to the Achaeans in their native land, set fire to their ships, in order that they might escape from the expected slavery, and at the same time, that they, being united in wedlock with those men, now compelled to stay, might have them for their husbands. The poet has also very admirably described them;[3] for one may see those women likewise, it seems, 'robe-trailing' and 'deep-bosomed'.

110 In the country of the Peucetians[4] they say there is a temple of Artemis, in which, they state, is dedicated the bronze necklace celebrated in those parts, with the inscription—'Diomede to Artemis'. Now the legend re-

[1] sc. to the goddess.
[2] Gr. εἰλεῖσθαι.
[3] *Il.* vi. 442, vii. 297, xiv. 105, xviii. 122.
[4] Πευκεντίνοις Sª. The Peucetii were a people of Apulia.

lates that he put it round the neck of a stag, and that it[1] adhered there; and in this way having been afterwards found by Agathocles, king of the Sicilians, it was, they affirm, dedicated in the temple of Zeus.[2]

On the promontory of Sicily, called the promontory of 111
Pelorus, it is stated that so much saffron grows that, while by some of the Greeks dwelling in those parts it is not known what a valuable flower it is, on the promontory of Pelorus all who wish bring home large waggon loads of it, and in the spring-time strew their beds and stages[3] with saffron.

Polycritus, who has written the history of Sicily in verse, 112
states that in a certain part of the interior there is a little lake, with a circumference about that of a shield, and this contains water transparent indeed, but somewhat turbid.
841a Now if any one enters this, intending to wash himself, it increases in breadth; but if a second person[4] enters, it grows wider still; and finally, having grown larger, it becomes wide enough for the reception of even fifty men. But whenever it has received this number, swelling up again from the bottom it casts the bodies of the bathers high in the air and out on the ground; but, as soon as this has occurred, it returns once more to the original form of its circumference. And not only in the case of men does this occur with regard to it, but also, if a quadruped enters, it experiences the same result.

In the dominion of the Carthaginians[5] they say there is 113
a mountain which is called Uranion,[6] full of all kinds of wood and variegated with many flowers, so that the contiguous places over a wide extent partaking of its fragrance waft to the travellers a most agreeable odour. Near this spot they say that there is a spring of oil, and that it has a smell like that of cedar sawdust. But they say that the person who approaches it must be chaste, and, if this is

[1] sc. the necklace. [2] We should probably read τῆς θεοῦ.

[3] This is difficult. Natalis renders 'cum . . . et thoros et umbracula faciant ex croco': so Montesaurus—'lectulos tentoriave sibi ex eo croco praeparant'. Schnitzer—*machen sie ihre Matratzen u. Zeltdecken aus Safran*. But probably A. means that they strew their couches and stages with the flowers of saffron, instead of the mere essence. Cf. Lucret. ii. 416; Ovid, *A. A.* i. 104.

[4] Sylburg conj. δεύτερος for MS. δεύτερον. [5] i. e. in Sicily.

[6] i. e. heavenly. Beckm. reads Γώνιον, Cod. Vind. Οὐνίον.

the case, it spouts up the oil in greater abundance, so that it can be safely drawn.

114 Men say that near this spring also there is a natural rock of great size. Now they say that when summer is come it sends up a flame of fire, but when winter arrives, from the same place it sends gushing up a stream of water so cold that, when compared with snow, it does not differ from it. And this, they declare, is not a secret occurrence, nor does it appear for only a short time; but it sends forth the fire throughout the whole summer, and the water throughout the whole winter.

115 It is reported that in that part of Thrace which is called the country of the Sinti and Maedi, there is a certain river named Pontus, in which are carried down certain stones which burn, and are of a nature opposed to that of charcoal from wood; for while fanned they are quickly extinguished, but when sprinkled with water they blaze up and kindle better. Now, when they are burning, they have a smell **841b** similar to that of bitumen, so bad and pungent that no creeping thing remains in the place while they are burning.

116 They say, moreover, that in their country there is a certain place, not very small, about twenty stadia in extent, that bears barley, which the men indeed use; but the horses and oxen, or any other animal, will not eat it: nay, not even does any pig or dog venture to taste the excrement of men who after eating a cake or bread made from this barley have voided it, as death results from it.

117 At Scotussae in Thessaly they say there is a little fountain from which flows water of such a kind that in a moment it heals wounds and bruises both of men and of beasts of burden;[1] and if any one throws wood into it, without having quite broken it, but having merely split it, this unites, and is restored again to its original state.

118 In Thrace above Amphipolis they say that a thing happens, which is wonderful and incredible to those who have not seen it; for the boys, going forth from the villages and neighbouring districts to catch little birds, take the

[1] Theopompus *ap.* Plin. xxxi. 2 makes the same statement, as also Sotion, *de Flum.* p. 124, on the authority of Isigonus. Cf. Antigonus Car. p. 157.

hawks to help in catching them, and they do so in this manner:—When they have advanced to a suitable spot they call the hawks by name with a loud cry; and, when they hear the boys' voice, they come and frighten away the birds; these in terror of them take refuge in the bushes, where the boys strike them down with sticks and capture them. But what one would be most of all surprised at is this—whenever the hawks themselves have seized any of the birds, they throw them down to the bird-catchers, while the boys return home, after giving some portion of all their booty to the hawks.

Another marvel also they say occurs among the Heneti:[1] 119
that countless myriads of jackdaws are frequently borne to their country, and eat up the corn when the people have sown it. To them the Heneti offer gifts, before the
842a birds are about to fly to the borders of the land, throwing before them seeds of all kinds of fruits. Now if the jackdaws taste these they do not come over into their country, and the Heneti know that they will be in peace; but, if they do not taste them, the people thereupon expect an attack to be made upon them by their enemies.

In the Thracian Chalcidice,[2] near Olynthus, they say 120
there is a place called Cantharolethros,[3] a little larger in size than a threshing-floor; and that when any other living creature reaches the spot it departs again; but none of the beetles that come there do so; but they going round and round the place die from hunger.

Among the Thracian Cyclopes there is a little spring 121
containing water, which in appearance indeed is pure, transparent, and like all others; but, when an animal drinks of it, straightway it perishes.

Men say that in Crastonia, near the country of the 122
Bisaltae, the hares that are captured have two livers; and that there is a certain place, about a rood in extent, into which whatever animal enters dies. There is in the same place, besides, a temple of Dionysus, large and beautiful, in which, when the festival and sacrifice take

[1] i. e. Venetians. [2] Beckm. reads Chalcis.
[3] i. e. Beetles' death.

place, it is said that a great blaze of fire is seen when the god is going to produce a good season, and that all those who are assembled round the sacred enclosure see it; when, however, he intends to cause unfruitfulness, this light is not seen, but darkness extends over the place, as during the other nights.

123 In Elis they relate that there is a certain building about eight furlongs distant from the city, in which, at the festival of Dionysus, they place three empty copper caldrons. Having done this, they request any of the Greeks staying in the city, who wishes, to examine the vessels, and to seal the doors of the house: then, when they are about to open them, they point out the seals to the citizens and strangers first of all, before they do so. They on entering find the caldrons indeed full of wine, but the floor and the walls uninjured, so that it is impossible to entertain a suspicion that they accomplish this by some trick. Moreover, they say that amongst the same people there are kites, which snatch
the meat from those who carry it through the market- **842b**
place, but do not touch the flesh of the sacred victims.

124 It is said that at Coronea in Boeotia the animals called moles cannot live, or dig up the ground, while the rest of Boeotia possesses a large number of them.

125 At Lusi[1] in Arcadia men say there is a certain spring in which field-mice are found and swim, passing their lives in it. The same thing is said to occur likewise at Lampsacus.

126 At Crannon in Thessaly they say there are only two crows[2] in the city. When these have hatched their young, they depart from the place, as it appears, but leave behind as many others of their offspring.

127 In Apollonia, which lies near to the country of the Taulantii,[3] they say there is bitumen obtained by digging, and pitch springing up from the earth, in the same manner

[1] *Λούσοις* Sylb.: MSS. *κολούσοις*. Antigonus, 152, on the authority of Theopompus, makes the same statement with regard to Lusi. So Plin. xxxi. 2.

[2] Cf. c. 137.

[3] Conj. Brodaeus instead of MS. *'Ατλαντίκων*. Holsten. conj. *'Ατιντάνων*. Apelt reads *'Ατλαντίνων*. Cf. c. 22. 36. *Ταυλαντίνων* conj. Bussemaker. Codex Vindobon. *'Αθπ̣λατίνων*. (The point beneath π implies that it is spurious.)

as springs of water, in no respect differing from that of Macedonia, but that it is naturally blacker and thicker than that. And not far from this place there is a fire burning at all times, as those who dwell in the neighbourhood assert. The burning place, it appears, is not large, but about the size of the space occupied by five couches. This spot smells of sulphur and alum,[1] and thick grass grows around, at which one would be most surprised, and also large trees, not four cubits distant from the fire. Moreover, a fire burns constantly in Lycia and near Megalopolis in Peloponnesus.

It is said also that among the Illyrians the cattle bring 128
forth young twice in the year, and that most of them have twins, and that many goats bring forth three or four kids at a time, and some even five or more ; and, besides, that they readily yield nine pints of milk. They say too that the hens do not lay merely once, as among other nations, but twice or thrice in the day.

It is said that the wild oxen in Paeonia are far larger 129
than those that are found in other nations, and that their horns contain twenty-four pints, and those of some of them even more.

843a Concerning the Sicilian Strait, apart from what many 130
other writers have written, this author[2] states that a portentous occurrence takes place : the billows, he says, being carried with a loud whistling sound from the Tyrrhenian Sea, dash against both the promontories, that of Sicily and that of Italy, which is called Rhegium, and being borne from a great sea are shut up in a narrow space ; and when this occurs they raise the waves with a loud roar in mid-air to a very great height, as they dash upwards, so that the rising of the waters is visible to those who are far away, not resembling the rising of the sea, but white and foaming, and similar to the sweeping movements which take place in excessively violent storms : and that sometimes the waves meet each other on both the promontories

[1] Or vitriol. [2] Polycritus probably. Cf. c. 112. Sylburg thinks that these two chapters should be connected together.

and produce a collision [1] incredible in description, and unendurable for the eyes to behold; but at other times parting, after dashing against each other, they show an abyss,[2] so deep and horrible to those who are compelled to look on, that many are unable to restrain themselves, and fall, blinded with terror. But when the waves, after dashing on either of the two places and being carried to the tops of the promontories, have descended again into the sea flowing beneath, then again with loud bellowing and great and swift eddies the sea boils up, and is lifted on high from the depths in confusion, and assumes alternately all kinds of hues, for it appears at one time dark, at another blue, and oftentimes of a purplish colour: but no creeping thing can endure either to hear or to see the quick rush and length of this sea, and besides these its ebb, but all flee to the low-lying skirts of the mountains; but, when the heaving of the billows ceases, the eddies are borne on high, making such various twistings that they seem to produce movements resembling the coils of presteres,[3] or some other large snakes.

131 Men say that, while the Athenians were building the **843b**
temple of Demeter at Eleusis, a brazen pillar was found surrounded with rocks, on which had been inscribed—'This is the tomb of Deïope', whom some state to have been the wife of Musaeus, others the mother of Triptolemus.

132 In one of the islands, called the islands of Aeolus, they say that a large number of palm-trees grow, whence it is also called 'Palm-island'; therefore that could not be true which is asserted by Callisthenes, that the tree [4] received its name from the Phoenicians, who inhabited the sea-coast of Syria. But some state that the Phoenicians themselves received this name from the Greeks, because they, first of all sailing over the sea, slew and murdered all, wherever they landed. And moreover in the language of the Perrhaebians the verb 'phoenixai' means 'to stain with blood'.[5]

[1] The Laurentian MS. reads *συγκλεισμόν*: so Beckm. The Cod. Vind. has *συγκλυσμόν*.
[2] lit. make the prospect.
[3] *πρηστήρων*. The bite of these snakes caused the victim to swell (*πρήθω*), and produced burning thirst. Cf. Lucan ix. 791 'torridus prester'. Cf. Diosc. ed. Spengel, II. 71. 675. Lenz, *Zool. d. Gr. u. Röm.* 469.
[4] i. e. phoenix.
[5] Nicander Alex. 187 has *φοινός* = *φόνος*. Cf. *φονεύω*.

In what is called the Aeniac district, in the neighbourhood of the city named Hypate,[1] an old pillar is said to have been discovered; and the Aenianians, wishing to know to whom it belonged, as it had an inscription in ancient characters, sent certain persons to take it to Athens. But as they were proceeding through Boeotia, and were communicating to some of their guest friends the object of their journey, it is said that they were conducted into the so-called Ismenium[2] at Thebes; for there the meaning of the inscription could be most easily discovered, they said, adding that there were in that place some ancient dedicatory offerings having the forms of the letters similar to those of the one in question: whence they say that, having found an explanation of the objects of their inquiry, from what was already known to them, they copied down the following lines:— 133

> I Heracles offered the grove to the beaming goddess Cythera,
> When I had Geryon's herds, and Erytheia for spoil;
> For with desire for her the goddess had vanquished my heart.
> But here my wife Erythe brings forth Erython as her offspring,
> Nymph-born maid Erythe, to whom I yielded the plain,
> Sacred memorial of love under the shade of the beech.

844ª With this inscription both that place corresponded, being called Erythus, and also the fact that it was from thence, and not from Erytheia, that he drove away the cows; for they say that nowhere either in the parts of Libya or Iberia is the name of Erytheia to be found.

In the city called Utica in Libya, which is situated, as they say, on the gulf between the promontory of Hermes[3] and that of Hippos, and about two hundred furlongs beyond Carthage (now Utica also is said to have been founded by Phoenicians two hundred and eighty-seven years before Carthage itself, as is recorded in the Phoenician histories), men state that salt is obtained by digging 134

[1] In Thessaly.
[2] i. e. temple of Ismenian Apollo.
[3] Utica lay between the Hermaeum Promontorium, mod. Râs el Kanâis, and the promontory of Apollo, mod. Râs Sidi Ali. Cf. Kiepert, who identifies the latter with C. Bon, though others identify it with C. Zibeeb, or C. Farina.

at a depth of eighteen feet, in appearance white and not solid, but resembling the most sticky gum; and that when brought into the sun it hardens, and becomes like Parian marble; and they say that from it are carved figures of animals, and utensils besides.

135 It is said that those of the Phoenicians who first sailed to Tartessus,[1] after importing to that place oil, and other small wares of maritime commerce, obtained for their return cargo so great a quantity of silver, that they were no longer able to keep or receive it, but were forced, when sailing away from those parts, to make of silver not only all the other articles which they used, but also all their anchors.

136 They say that the Phoenicians who inhabit the city called Gades, when they sail outside the Pillars of Heracles under an easterly wind for four days, arrive at certain desolate places, full of rushes and seaweed, and that these places are not covered with water, whenever there is an ebb, but, whenever there is a flood, they are overflowed, and in these there is found an exceeding great number of tunnies, of a size and thickness surpassing belief, when they are stranded. These they salt, pack up in vessels, and convey to Carthage. They are the only fish which the Carthaginians do not export; on account of their excellence for food, they consume them themselves.

137 In the district of Pedasa in Caria a sacrifice is celebrated in honour of Zeus, at which they send in the procession 844b a she-goat, with regard to which they say that a marvellous thing occurs; for while it proceeds from Pedasa a distance of seventy furlongs, through a dense crowd of people looking on, it is neither disturbed in its progress, nor is turned out of the way, but, being tied with a rope, advances before the man who holds the priesthood.

[And they say that its horns contain twenty-four pints, and in some cases even more.] What is wonderful is that two crows stay continually about the temple of Zeus, while

[1] A Phoenician settlement, probably the Tarshish of Scripture. It has been identified with the city of Carteia on Mt. Calpe, mod. Gibraltar.

no other approaches the spot, and that one of them has the front part of its neck white.

In the country of those Illyrians who are called Ardiaei, 138
near the boundaries separating them from the Antariates, they say there is a great mountain, and near this a valley, from which water springs up, not at every season, but during the spring, in great abundance; which the people take, and keep during the day indeed in a cellar, but during the night they set it in the open air. And, after they have done this for five or six days, the water congeals, and becomes the most excellent salt, which they preserve especially for the sake of the cattle: for salt is not imported to them, because they live at a distance from the sea, and have no intercourse with others. They have therefore most need of it for their cattle; for they supply them with salt twice in the year; but if they fail to do this, the result is that most of their cattle perish.

In Argos they say there is a species of locust which 139
is called the scorpion-fighter;[1] for, as soon as it sees a scorpion, it attacks him, and likewise the scorpion attacks it. It chirps as it goes round him in a circle. The other, they say, raises his sting, and turns it round against his adversary in the same spot; then he gradually lets his sting drop, and at last stretches himself out altogether on the ground, while the locust runs round him. At last the locust approaches and devours him. They say that it is good to eat the locust as an antidote against the scorpion's sting.

They say that the wasps in Naxos, when they have 140
tasted the flesh of the viper (and its flesh, as it appears, is agreeable to them), and when they have afterwards stung any one, inflict so much pain, that their sting seems more dangerous than that of the vipers.

845a They say that the Scythian poison, in which that people 141
dips its arrows, is procured from the viper. The Scythians, it would appear, watch those that are just bringing forth young, and take them, and allow them to putrefy for some days. But when the whole mass appears to them

[1] Similar to this was the locust called *ὀφιομάχος*. That in the text may be the wingless locust called *ἀσίρακος* or *ὄνος* by Dioscor. ii. 57, who says that the Libyans at Leptis eat them greedily.

to have become sufficiently rotten, they pour human blood into a little pot, and, after covering it with a lid, bury it in a dung-hill. And when this likewise has putrefied, they mix that which settles on the top,[1] which is of a watery nature, with the corrupted blood of the viper, and thus make it a deadly poison.

142 At Curium[2] in Cyprus they say there is a species of snake, which has similar power to that of the asp in Egypt, except that, if it bites in the winter, it produces no effect, whether from some other reason, or because when congealed with cold the reptile loses its power of movement, and becomes completely powerless, unless it be warmed.

143 In Ceos they say there is a species of wild pear[3] of such a kind that, if any one be wounded by its thorn, he dies.

144 In Mysia they say there is a white species of bears, which, when they are hunted, emit a breath of such a kind as to rot the flesh of the dogs, and likewise of other wild beasts, and render them unfit for food. But, if any one approaches them with violence, they discharge, it appears, from the mouth a very great quantity of phlegm, which the animal blows upon the faces of the dogs, and of the men as well, so as to choke and blind them.

145 In Arabia they say there is a certain kind of hyaena, which, when it sees some wild beast, before being itself seen, or steps on the shadow of a man, produces speechlessness, and fixes them to the spot in such a way that they cannot move their body; and it is said that they do this in the case of dogs also.

146 In Syria they say there is an animal, which is called the lion-killer; for the lion, it seems, dies, whenever he eats any of it. He does not indeed do this willingly, but rather flees from the animal; but when the hunters, having caught and roasted it, sprinkle it, like white meal, over some other animal, they say that the lion, after tasting it, dies on the spot. This animal injures the lion even by making water upon it.

[1] Bonitz conj. *ἐφιστάμενον.*

[2] Cf. c. 43.

[3] The Schol. on Theocr. 24. 88 explains the word as *ἀκανθῶδες φυτὸν ἐξ οὗ τὰς αἱμασιὰς ποιοῦσι, ἤγουν ἡ ἄπιος ἡ ἀγρία.*

It is said also that vultures die from the smell of 147
845b unguents,[1] if any one anoints them, or gives them something smeared with an unguent to eat: likewise they say that beetles also die from the smell of roses.

They say that both in Sicily and Italy the star-lizards 148
have a deadly bite, and not like those among ourselves a weak and soft bite: moreover that there is a sort of mice, which flies at people, and, when it bites, causes them to die.

In Mesopotamia, a region of Syria, and at Istrus,[2] they 149
say that there are certain little snakes, which do not bite the people of the country, but do great injury to strangers.

At the Euphrates they say that this especially happens; 150
for that many are seen about the edges of the river, swimming also towards either bank; so that while seen in the evening on this side, at daybreak they appear on the other side; and that they refrain from biting such of the Syrians as are taking their repose, but do not spare the Greeks.

In Thessaly they say that the snake which is called 151
sacred destroys all persons, not merely if it bites, but even if it touches them; and so when it appears (but it appears rarely), and they hear its voice, both serpents and vipers, and all the other wild beasts flee. It is not large, but of a moderate size. In the city of Tenos in Thessaly they say it was once destroyed by a woman, and that its death happened in the following manner:—The woman, having described a circle and put the charms therein, entered into the circle, herself and her son, and then imitated the hissing of the beast; it answered the sound of her voice and approached; but, while it was hissing, the woman fell asleep, and the more profoundly, the closer it drew nigh, so that she could not overcome the power of sleep: but her son, sitting beside her, aroused her by striking her, as she had bidden him to do, saying that, if she fell asleep, both she and he should perish, whereas if she used force, and drew the animal towards her, they

[1] Phile, p. 9, states that beetles also die from this, while Eustath. says that if smeared with an extract of roses they die at once.

[2] Tiryns? conj. Holsten from Plin. viii. 59. It is asserted that the scorpions of Mt. Latmos do just the reverse. Cf. Antigonus, 18.

should be saved. But the snake, when it came up to the circle, immediately withered away.

152 It is said that near Tyana there is water sacred to Zeus Horcios[1]—they call it Asbamaeon—whose spring rises very cold, but boils up like caldrons. This water is sweet 846a
and propitious to those who observe their oaths; but punishment follows on the heels of the perjured; for it falls upon their eyes, hands, and feet, and they are seized with dropsies and consumptions; and it is not even possible to get away beforehand, but they are held on the spot, and lament beside the water, confessing the perjuries they have committed.

153 At Athens they say that the sacred branch of the olive tree[2] in one day buds and increases, but quickly shrinks together again.

154 When the craters in Etna once burst forth, and the lava was carried hither and thither over the land like a torrent, the deity honoured the race of the pious; for when they were hemmed in on all sides by the stream, because they were bearing their aged parents on their shoulders, and were trying to save them, the stream of fire, having come near to them, was cleft asunder, and turned aside one part of the flame in this direction, another in that, and preserved the young men unharmed, along with their parents.

155 It is said that the sculptor Phidias, while constructing the Athene in the Acropolis, carved his own face in the centre of her shield, and connected it by an imperceptible artifice with the statue, so that, if any one wished to remove it, he must necessarily break up and destroy the whole statue.

156 They say that the statue of Bitys in Argos killed the man who had caused the death of Bitys, by falling upon him while he was looking at a spectacle. It appears therefore that such events do not happen at random.[3]

157 Men say that the dogs pursue the wild beasts only to

[1] i. e. who watches over oaths.

[2] It was called πάγκυφος, and ἀστή. The Schol. on Arist. *Nub.* 1001 says that the sacred olives of Athene on the Acropolis were also called μορίαι.

[3] Cf. Ar. *Poet.* 9.

the summits of the so-called Black Mountains, but turn
back when they have pursued them as far as these.

In the river Phasis it is related that a rod called the 158
'White-leaved' grows, which jealous husbands pluck, and
throw round the bridal-bed,[1] and thus preserve their
marriage unadulterated.

In the Tigris they say there is a stone found, called in 159
the barbarian language Modon, with a very white colour,
and that, if any one possesses this, he is not harmed by
wild beasts.

In the Scamander they say a plant grows, called Sistros,[2] 160
resembling chick-pea, and that it has seeds that shake,
from which fact it has obtained its name: those who
possess it (so it is said) fear neither demon nor spectre
of any kind.

In Libya there is a vine, which some people call mad, 161
846b that ripens some of its fruit, others it has like unripe grapes,
and others in blossom, and this during a short time.

On Mount Sipylus they say there is a stone like a 162
cylinder, which, when pious sons have found it, they place
in the sacred precincts of the Mother of the Gods, and
never err through impiety, but are always affectionate to
their parents.

On Mount Taÿgetus (it is said) there is a plant called 163
Charisia,[3] which women in the beginning of spring fasten
round their necks, and are loved more passionately by their
husbands.

Othrys is a mountain of Thessaly, which produces 164
serpents that are called Sepes,[4] which have not a single
colour, but always resemble the place in which they live.
Some of them have a colour like that of land-snails, while
the scales of others are of a bright green; but all of them
that dwell in the sands become like these in colour. When
they bite they produce thirst. Now their bite is not rough
and fiery, but malicious.

[1] lit. maiden bed-chamber.
[2] i. e. shaking-plant.
[3] i. e. love-plant.
[4] i. e. putrefaction-serpents.

165 When the dark-coloured adder copulates with the female, the female during the copulation bites off the head of the male; therefore also her young ones, as though avenging their father's death, burst through their mother's belly.

166 In the river Nile they say that a stone like a bean is produced, and that, if dogs see it, they do not bark. It is beneficial also to those who are possessed by some demon; for, as soon as it is applied to the nostrils, the demon departs.

167 In the Maeander, a river of Asia, they say that a stone is found, called by contradiction 'sound-minded'; for if one throws it into any one's bosom he becomes mad, and kills some one of his relations.

168 The rivers Rhine and Danube flow towards the north, one passing the Germans, the other the Paeonians. In the summer they have a navigable stream, but in the winter they are congealed from the cold, and form a plain over which men ride.

169 Near the city of Thurium they say there are two rivers, the Sybaris and the Crathis. Now the Sybaris causes the horses that drink of it to be timorous, while the Crathis makes men yellow-haired when they bathe in it.

170 In Euboea there are said to be two rivers; the sheep that drink from one of them become white; it is called Cerbes: the other is the Neleus, which makes them black.

171 Near the river Lycormas[1] it is said that a plant[2] grows, 847a which is like a lance, and is most beneficial in the case of dim sight.

172 They say that the fountain of Arethusa at Syracuse in Sicily is set in motion every five years.

173 On Mount Berecynthius[3] it is said that a stone is produced called 'the Sword', and if any one finds it, while the mysteries of Hecate are being celebrated, he becomes mad, as Eudoxus affirms.

[1] A river of Aetolia, Plut. *de Fluv.* 8.
[2] It was called *σάρισσα* from its shape.
[3] In Phrygia, sacred to Cybele. It is elsewhere written Βερέκυντος.

On Mount Tmolus[1] it is said that a stone is produced 174
like pumice-stone, which changes its colour four times
in the day; and that it is only seen by maidens who
have not yet attained to years of discretion.

847b On the altar of the Orthosian[2] Artemis it is said that 175
a golden bull stands, which bellows when hunters enter
the temple.

Among the Aetolians it is said that moles see, but only 176
dimly, and do not feed on the earth, but on locusts.

They say that elephants are pregnant during the space 177
of two years, while others say during eighteen months;
and that in bringing forth they suffer hard labour.

They say that Demaratus, the pupil of the Locrian 178
Timaeus, having fallen sick, was dumb for ten days; but
on the eleventh, having slowly come to his senses after
his delirium, he declared that during that time he had
lived most agreeably.

[1] A mountain of Lydia, mod. Boz-dagh, from which the Pactolus rises.

[2] She was also called Orthia, from Mt. Orthium or Orthosium in Arcadia. Cf. Hesych. *'Ορθία, "Αρτεμις, οὕτως εἴρηται ἀπὸ τοῦ ἐν 'Αρκαδίᾳ χωρίον, ἔνθα ἱερὸν 'Αρτέμιδος ἵδρυται.*

MECHANICA

BY

E. S. FORSTER

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PREFACE

Whilst the scientific standpoint of the *Mechanica* is certainly Peripatetic, the writer's interest in the practical application of the problems involved is quite un-Aristotelian. The text used for this translation is that of O. Apelt (Teubner, 1888). The edition of J. P. van Capelle (Amsterdam, 1812) has been invaluable both for its *apparatus criticus* and for its commentary.

My warmest thanks are due to Mr. W. D. Ross, Fellow of Oriel College, for many valuable suggestions, and to my father, Mr. M. S. Forster, M.A., B.C.L., B.Sc., whose constant advice, particularly on scientific points, has assisted me on every page of this treatise.

E. S. F.

CONTENTS

MECHANICA

OUR wonder is excited, firstly, by phenomena which occur 847a
in accordance with nature but of which we do not know the cause, and secondly by those which are produced by art despite nature for the benefit of mankind. Nature often operates contrary to human expediency; for she always follows the same course without deviation, whereas human expediency is always changing. When, therefore, we have to do something contrary to nature, the difficulty of it causes us perplexity and art has to be called to our aid. The kind of art which helps us in such perplexities we call Mechanical Skill. The words of the poet Antiphon are quite true:

'Mastered by Nature, we o'ercome by Art.'

Instances of this are those cases in which the less prevails over the greater, and where forces of small motive power move great weights—in fact, practically all those problems which we call Mechanical Problems. They are not quite identical nor yet entirely unconnected with Natural Problems. They have something in common both with Mathematical and with Natural Speculations; for while Mathematics demonstrates *how* phenomena come to pass; Natural Science demonstrates *in what medium* they occur.

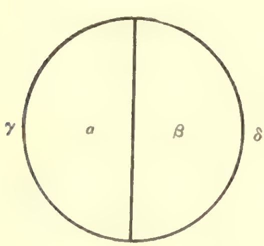
Among questions of a mechanical kind are included 847b
those which are connected with the lever. It seems strange that a great weight can be moved with but little force, and that when the addition of more weight is involved; for the very same weight, which one cannot move at all without a lever, one can move quite easily with it, in spite of the additional weight of the lever.

The original cause of all such phenomena is the circle. It is quite natural that this should be so; for there is nothing strange in a lesser marvel being caused by a greater

marvel, and it is a very great marvel that contraries should be present together, and the circle is made up of contraries. For to begin with, it is formed by motion and rest,[1] things which are by nature opposed to one another. Hence in examining the circle we need not be much astonished at the contradictions which occur in connexion with it. Firstly, in the line which encloses the circle, being without breadth, two contraries somehow appear, namely, the concave and the convex. These are as much opposed to one another as the great is to the small; the mean being in the latter case the equal, in the former the straight. Therefore just as, if they are to change into one another, the greater and smaller must become equal before they can
848a pass into the other extreme; so a line must become straight in passing from convex into concave, or on the other hand from concave into convex and curved. This, then, is one peculiarity of the circle.

Another peculiarity of the circle is that it moves in two contrary directions at the same time; for it moves simultaneously to a forward and a backward position.[2] Such, too, is the nature of the radius which describes a circle. For its extremity comes back again to the same position from which it starts; for, when it moves continuously, its last position is a return to its original position, in such a way that it has clearly undergone a change from that position.

Therefore, as has already been remarked, there is nothing strange in the circle being the origin of any and every marvel. The phenomena observed in the balance can be referred to the circle, and those observed in the lever to the balance; while practically all the other phenomena of mechanical motion are connected with the lever. Furthermore, since no two points on one and the



[1] 847b 20. i.e. by the motion of a line round a fixed point.

[2] 848a 5. If a circle be divided into two halves α and β, when the circle is revolved in a forward direction α will move towards δ and β towards γ.

same radius travel with the same rapidity, but of two points that which is further from the fixed centre travels more quickly, many marvellous phenomena occur in the motions of circles, which will be demonstrated in the following problems.

Because a circle moves in two contrary forms of motion at the same time, and because one extremity of the diameter, A, moves forwards and the other, B, moves backwards, some people contrive so that as the result of a single movement a number of circles move simultaneously in contrary directions, like the wheels of brass and iron which they make and dedicate in the temples. Let AB be a circle and ΓΔ another circle in contact with it; then if

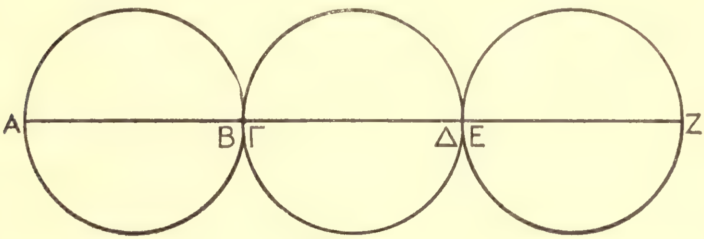


FIG. 1.

the diameter of the circle AB moves forward, the diameter ΓΔ will move in a backward direction as compared with the circle AB, as long as the diameter moves round the same point. The circle ΓΔ therefore will move in the opposite direction to the circle AB. Again, the circle ΓΔ will itself make the adjoining circle EZ move in an opposite direction to itself for the same reason. The same thing will happen in the case of a larger number of circles, only one of them being set in motion. Mechanicians seizing on this inherent peculiarity of the circle, and hiding the principle, construct an instrument so as to exhibit the marvellous character of the device, while they obscure the cause of it.

1 FIRST, then, a question arises as to what takes place in the case of the balance. Why are larger balances more accurate than smaller? And the fundamental principle of this is, why is it that the radius which extends further from 848b

the centre is displaced quicker than the smaller radius, when the near radius is moved by the same force? Now we use the word 'quicker' in two senses; if an object traverses an equal distance in less time, we call it quicker, and also if it traverses a greater distance in equal time. Now the greater radius describes a greater circle in equal time; for the outer circumference is greater than the inner. The reason of this is that the radius undergoes two displacements. Now if the two displacements of a body are in any fixed proportion, the resulting displacement must necessarily be a straight line, and this[1] line is the diagonal of the figure, made by the lines drawn in this proportion. Let the proportion of the two displacements be as AB to

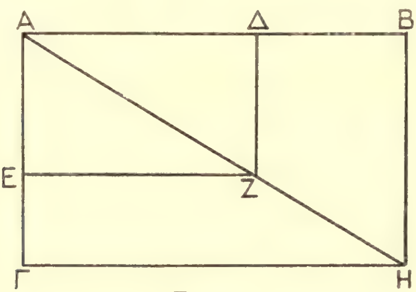


FIG. 2.

AΓ,[2] and let A be brought[3] to B, and the line AB brought down to HΓ. Again, let A be brought to Δ and the line AB to E; then if the proportion of the two displacements be maintained, AΔ must necessarily have the same proportion to AE as AB to AΓ. Therefore the small parallelogram is similar to the greater, and their diagonal is the same, so that A will be at Z. In the same way it can be shown, at whatever points the displacement be arrested, that the point A will in all cases be on the diagonal.

And the converse is also true. It is plain that, if a point be moved along the diagonal by two displacements, it is necessarily moved according to the proportion of the sides

[1] 848^b 12. Reading (with Par. A) *αὕτη*.

[2] 848^b 15. This proposition is known as the Proof of the Parallelogram of Forces and Distances.

[3] 848^b 16. Reading *τὸ μὲν* A *φερέσθω*.

of the parallelogram; for otherwise it will not be moved along the diagonal. If it be moved in two displacements in no fixed ratio for any time, its displacement cannot be in a straight line. For let it be a straight line. This then being drawn as a diagonal, and the sides of the parallelogram filled in, the point must necessarily be moved according to the proportion of the sides; for this has already been proved. Therefore, if the same proportion be not maintained during any interval of time, the point will not describe a straight line; for, if the proportion were maintained during any interval, the point must necessarily describe a straight line, by the reasoning above. So that, if the two displacements do not maintain any proportion during any interval, a curve is produced.

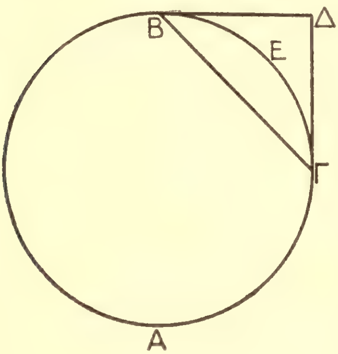


Fig. 3.

Now that the radius of a circle has two simultaneous displacements is plain from these considerations, and because the point[1] from being vertically above the 849a
centre comes back to the perpendicular, so as to be again perpendicularly above the centre.

Let ABΓ be a circle, and let the point B at the summit be displaced to Δ by one force, and come eventually to Γ by the other force. If then it were moved in the proportion of BΔ to ΔΓ, it would move along the diagonal BΓ. But in the present case, as it is moved in no such proportion, it moves along the curve BEΓ. And, if one of two displacements caused by the same forces is more interfered with and the other less, it is reasonable to suppose that the motion more interfered with will be slower than the motion less interfered with; which seems to happen in the case of the greater and less of the radii of circles. For on account

[1] 849a 1. Omitting *κατ' εὐθεῖαν* which, as Capelle says, is probably corrupt. If not, it must mean moving momentarily straight, and being immediately deflected. If it continued straight, it would not come back to the original position.

of the extremity of the lesser radius being nearer the stationary centre than that of the greater, being as it were pulled in a contrary direction, towards the middle,[1] the extremity of the lesser moves more slowly. This is the case with every radius, and it moves in a curve, naturally along the tangent, and unnaturally towards the centre. And the lesser radius is always moved more in respect of its unnatural motion; for being nearer to the retarding centre it is more constrained. And that the less of two radii having the same centre is moved more than the greater in respect of the unnatural motion is plain from what follows.

Let ΒΓΕΔ be a circle, and ΧΝΜΞ another smaller circle within it, both having the same centre A, and let the diameters be drawn, ΓΔ and BE in the large circle, and MX and ΝΞ in the small; and let the rectangle ΔΨΡΓ be completed. If the radius AB comes back to the same position from which it started, i.e. to AB, it is plain that it moved towards itself; and likewise AX will come to AX. But AX moves more slowly than AB, as has been stated, because the interference is greater and AX is more retarded.

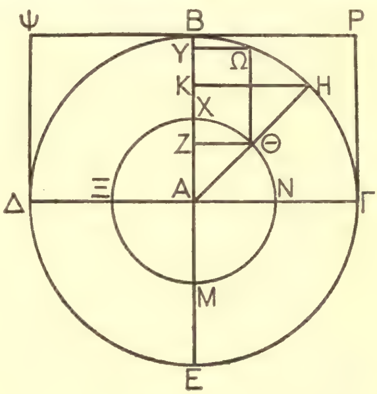


Fig. 4.

Now let ΑΘΗ be drawn, and from Θ a perpendicular upon AB within the circle, ΘZ; and, further, from Θ let ΘΩ be drawn parallel to AB, and ΩΥ and HK perpendiculars on AB; then ΩΥ and ΘZ are equal. Therefore BΥ is less than XZ; for in unequal circles equal straight lines drawn perpendicular to the diameter cut off smaller portions of the diameter in the greater circles; ΩΥ and ΘZ being equal.[2]

[1] 849a 13. Punctuating εἰς τὸ ἐναντίον ἐπὶ τὸ μέσον, βραδύτερον.

[2] 849a 38. According to the parallelogram of distances, the result ought to be:—BΥ : ΥΩ : : XZ : ΘZ, but it is proved that ΥΩ and ΘZ are equal, but BΥ and XZ unequal: so that the theory of the parallelogram

Now the radius AΘ describes the arc XΘ in the same time as the extremity of the radius BA has described an arc greater than BΩ in the greater circle; for the natural displacement is equal and the unnatural less, BΥ being less than XZ. Whereas they ought to be in proportion, the two natural motions in the same ratio to each other as the two unnatural motions. 849b

Now the radius AB has described an arc BH greater than BΩ. It must necessarily have described BH in the time in which X describes XΘ; for that will be its position when in the two circles the proportion between the unnatural and natural movements holds good. If, then, the natural movement is greater in the greater circle, the unnatural movement, too, would agree in being proportionally greater[1] in that case only, where B is moved along BH while X is moved along XΘ. For in that case the point B comes by its natural movement to H, and by its unnatural movement to K, HK being perpendicular from H. And as HK to BK, so is ΘZ to XZ. Which will be plain, if B and X be joined to H and Θ.[2] But, if the arc described by B be less or greater than HB, the result will not be the same, nor will the natural movement be proportional to the unnatural in the two circles.

So that the reason why the point further from the centre is moved quicker by the same force, and the greater radius describes the greater circle, is plain from what has been said; and hence the reason is also clear why larger balances are more accurate than smaller. For the cord by which a balance is suspended acts as the centre, for it is at rest, and the parts of the balance on either side form the radii. Therefore by the same weight the end of the balance must necessarily be moved quicker in proportion as it is more distant from the cord, and some weight must be imperceptible to the senses in small balances, but perceptible in large balances; for there is nothing to prevent the

fails. Why is this? The answer is that the same force moves longer radii quicker than shorter.

[1] 849b 11. Reading with Capelle μεῖζον for μᾶλλον.

[2] 849a 16. For the triangles BKH and XZΘ are similar, having all their sides parallel, each to each.

movement being so small as to be invisible to the eye. Whereas in the large balance the same load makes the movement visible. In some cases the effect is clearly seen in both balances, but much more in the larger on account of the amplitude of the displacement caused by the same load being much greater in the larger balance. And thus dealers in purple, in weighing it, use contrivances with intent to deceive, putting the cord out of centre and pouring lead into one arm of the balance, or using the wood towards the root of a tree for the end towards which they want it to incline, or a knot, if there be one in the wood; for the part of the wood where the root is is heavier, and a knot
850[a] is a kind of root.

How is it that if the cord is attached to the upper surface 2
of the beam of a balance, if one takes away the weight when the balance is depressed on one side, the beam rises again; whereas, if the cord is attached to the lower surface of the beam, it does not rise but remains in the same position. Is it because, when the cord is attached above, there is more of the beam on one side of the perpendicular than on the other, the cord being the perpendicular? In that case the side on which the greater part of the beam is must necessarily sink until the line which divides the beam into two equal parts reaches the actual perpendicular, since the weight now presses on the side of the beam which is elevated.

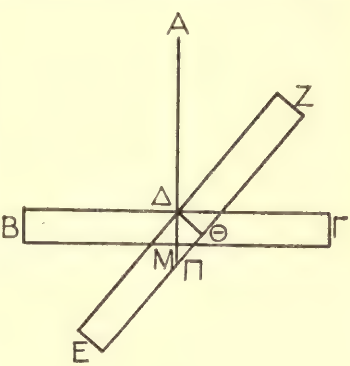


FIG. 5.

Let BΓ be a straight beam, and AΔ a cord. If AΔ be produced it will form the perpendicular AΔM. If the portion of the beam towards B be depressed, B will be displaced to E and Γ to Z; and so the line dividing the beam into two halves, which was originally ΔM, part of the perpendicular, will become ΔΘ when the beam is depressed; so that the part of the beam EZ which is outside the perpendicular ΛM will be greater by ΘΠ than half the beam. If therefore the weight at E be taken away, Z must sink, because the side towards E is shorter. It has been proved then that when the cord is attached above, if the weight be removed the beam rises again.

But if the support be from below, the contrary takes place. For then the part which is depressed is more than half of the beam, or in other words, more than the part marked off by the original perpendicular; it does not therefore rise, when the weight is removed, for the part that is elevated is lighter. Let NΞ be the beam when horizontal, and KΛM the perpendicular dividing NΞ into two halves. When the weight is placed at N, N will be displaced to O and Ξ to P, and KΛ to ΛΘ, so that KO[1] is greater than ΛP by ΘΛK. If the weight, therefore, is removed the beam must necessarily remain in the same position; for the excess of the part in which OK[2] is over half the beam acts as a weight and remains depressed.

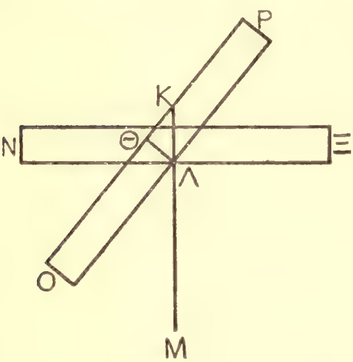


FIG. 6.

3 WHY is it that, as has been remarked at the beginning of this treatise,[3] the exercise of little force raises great weights with the help of a lever, in spite of the added weight of the lever; whereas the less heavy a weight is, the easier it is to move, and the weight is less without the lever? Does the reason lie in the fact that the lever acts like the beam of a balance with the cord attached below and

[1] 850^{a} 27. i.e. the figure KΛOΘ is greater than the figure KPΛ by twice the triangle KΛΘ.

[2] 850^{a} 29. Reading τὸ OK for τὸ K; Capelle apparently uses this reading in his translation, but has not altered the text.

[3] Cp. 847^{b} 2.

divided into two unequal parts? The fulcrum, then, takes the place of the cord, for both remain at rest and act as the centre. Now since a longer radius moves more quickly than a shorter one under pressure of an equal weight; and since the lever requires three elements, viz. the fulcrum —corresponding to the cord of a balance and forming the centre—and two weights, that exerted by the person using the lever and the weight which is to be moved; this being so, as the weight moved is to the weight moving it, so,
850b inversely, is the length of the arm bearing the weight to the length of the arm nearer to the power. The further one is from the fulcrum, the more easily will one raise the weight; the reason being that which has already been stated,[1] namely, that a longer radius describes a larger circle. So with the exertion of the same force the motive weight will change its position more than the weight which it moves, because it is further from the fulcrum.

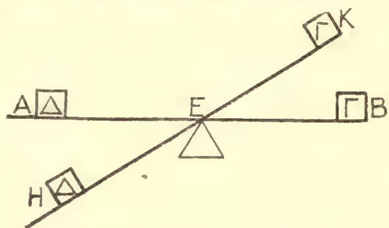


Fig. 7.

Let AB be a lever, Γ the weight to be lifted, Δ the motive weight, and E the fulcrum; the position of Δ after it has raised the weight will be H, and that of Γ, the weight raised, will be K.

Why is it that those rowers who are amidships move the ship most? Is it because the oar acts as a lever? The fulcrum then is the thole-pin (for it remains in the same place); and the weight is the sea which the oar displaces; and the power that moves the lever is the rower. The further he who moves a weight is from the fulcrum, the greater is the weight which he moves; for then the radius becomes greater, and the thole-pin acting as the fulcrum is the centre. Now amidships there is more of the oar inside the ship than elsewhere; for there the ship is widest, so that on both sides a longer portion of the oar can be 4

[1] Ch. 1.

inside the two walls of the vessel. The ship then moves because, as the blade presses against the sea, the handle of the oar, which is inside the ship, advances forward, and the ship, being firmly attached to the thole-pin, advances with it in the same direction as the handle of the oar. For where the blade displaces most water, there necessarily must the ship be propelled most; and it displaces most water where the handle is furthest from the thole-pin. This is why the rowers who are amidships move the ship most; for it is in the middle of the ship that the length of the oar from the thole-pin inside the ship is greatest.

5 Why is it that the rudder, being small and at the extreme end of the ship, has such power that vessels of great burden can be moved by a small tiller and the strength of one man only gently exerted? Is it because the rudder, too, is a lever and the steersman works it? The fulcrum then is the point at which the rudder is attached to the ship, and the whole rudder is the lever, and the sea is the weight, and the steersman the moving force. The rudder does not take the sea squarely, as the oar does; for it does not move the ship forward, but diverts it as it moves, taking the sea obliquely. For since, as we saw, the sea is the weight, the rudder pressing in a contrary direction diverts the ship. For the fulcrum turns in a contrary direction to the sea; when the sea turns inwards, the fulcrum turns 851a
outwards; and the ship follows it because it is attached to it. The oar pushing the weight squarely, and being itself thrust in turn by it, impels the ship straight forward; but the rudder, as it has an oblique position, causes an oblique motion one way or the other. It is placed at the stern and not amidships, because it is easiest to move a mass which has to be moved, if it is moved from one extremity. For the fore part travels quickest, because, just as in objects that are travelling along, the movement ceases at the end; so, too, in any object which is continuous the movement is weakest towards the end,[1] and if it is weakest in that part

[1] 851a 10. The author's theory seems to be that in a continuous

it is easy to check it. For this reason, then, the rudder is placed at the stern, and also because, as there is little motion there, the displacement is much greater at the extremity, since the equal angle stands on a longer base in proportion as the enclosing lines are longer.[1] From this it is also plain why the ship advances in the opposite direction more than does the oar-blade; for the same bulk moved by the same force progresses more in air than in water. For let AB be the oar and Γ the thole-pin, and A the end of the oar inside the ship, and B, that in the sea. Then if A be moved to Δ, B will not be at E; for BE is equal to AΔ, and so B, if it were at E, would have changed its position as much as A,

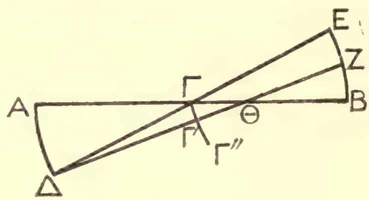
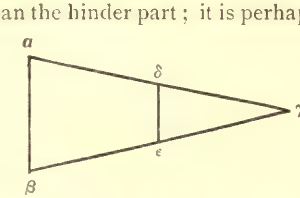


Fig. 8.

whereas it has really, as we saw, traversed a shorter distance. B will therefore be at Z. Θ then cuts AB not at Γ but below it. For BZ is less than AΔ, so that ΘZ is less than ΔΘ, for the triangles are similar. The centre Γ will also have been displaced; for it moves in a contrary direction to B, the end of the oar in the sea, and in the same direction as A, the end in the ship, and A changes its position to Δ. So the ship will also change its position, and it advances in the same direction as the handle of the oar. The rudder also acts in the same way, except that, as we saw above, it contributes nothing to the forward motion of the ship, but merely thrusts the stern sideways one way or the other;

object the fore part has more motion than the hinder part; it is perhaps due to a false generalization from the fact that in the case of a horse and cart, the motive power is in front.

[1] 851ª 15. Let $\alpha\gamma$ and $\beta\gamma$ be two positions of the boat, α and β being the stern and γ the bow; $\alpha\gamma$ and $\beta\gamma$ will be αἱ περιέχουσαι and the angle at γ ἡ ἴση γωνία. A force acting along $\alpha\beta$ need not be so great as one acting along $\delta\epsilon$ in order to move the same mass about the apex of the triangle.



for then the bow inclines in the contrary direction. The point where the rudder is attached must be considered, as it were, the centre of the mass which is moved, corresponding to the thole-pin in the case of the oar; but the middle of the ship moves in the direction to which the tiller is put over. If the steersman puts it inwards, the stern alters its position in that direction, but the bow inclines in the contrary direction; for while the bow remains in the same place, the position of the ship as a whole is altered.

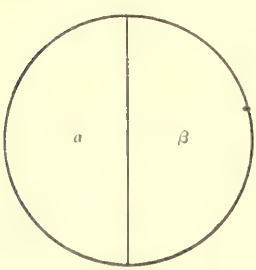
6 Why is it that the higher the yard-arm is raised, the quicker does a vessel travel with the same sail and in the same breeze?[1] Is it because the mast is a lever, and the socket in which it is fixed, the fulcrum, and the weight 851b
which it has to move is the boat, and the motive power is the wind in the sail? If the same power moves the same weight more easily and quickly the further away the fulcrum is, then the yard-arm, being raised higher, brings the sail also further away from the mast-socket, which is the fulcrum.

7 Why is it that, when sailors wish to keep their course in an unfavourable wind, they draw in the part of the sail which is nearer to the steersman, and, working the sheet, let out the part towards the bows? Is it because the rudder cannot counteract the wind when it is strong, but can do so when there is only a little wind, and so[2] they draw in sail? The wind then bears the ship along, while the rudder turns the wind into a favouring breeze, counteracting it and serving as a lever against the sea. The sailors also at the same time contend with the wind by leaning their weight in the opposite direction.

[1] 851a 40. The only effect of raising the yard-arm would be to make the vessel heel over more with a side wind or to depress the bows if the wind was astern, or the stern if the wind were ahead. The most probable explanation is that the Greek sailor, being essentially a coaster, preferred a high sail in order to catch the wind which might be cut off by hills and cliffs.

[2] 851b 10. Reading with Bussemaker διό for ὅ.

WHY is it that spherical and circular forms are easier 8
to move? A circle can revolve in three different ways: either along its circumference, the centre correspondingly changing its position, as a carriage wheel revolves; or round the centre only, as pulleys move, the centre being at rest; or it can turn, as does the potter's wheel, parallel to the ground, the centre being at rest. Do not circular forms move quickest, firstly because they have a very slight contact with the ground (like a circle in contact at a single point), and secondly, because there is no friction, for the angle[1] is well away from the ground? Further, if they come into collision with another body, they only are in contact with it again to a very small extent. (If it were a question of a rectilinear body, owing to its sides being straight, it would have a considerable contact with the ground.) Further, he who moves circular objects moves them in a direction to which they have an inclination as regards weight. For when the diameter of the circle is perpendicular to the ground, the circle being in contact with the ground only at one point, the diameter divides the weight equally on either side of it; but as soon as it is set in motion, there is more weight on the side to which it is moved, as though it had an inclination in that direction.[2] Hence, it is easier for one who pushes it forward to move it; for it is easier to move any body in a direction to which it inclines, just as it is difficult to move it contrary to its inclination. Some people further assert that the circumference of a circle keeps up a continual motion, just as bodies which are at rest remain so owing to their resistance.[3]



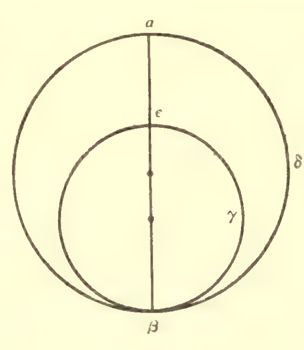
[1] 851b 24. i.e. the circumference which forms an angle with the ground.

[2] 851b 32. i.e. if the circle be divided by the diameter into two halves α and β, when the circle is rolled forward part of β will be transferred to α. The author does not perceive that it is equally true that part of α is transferred to β.

[3] 851b 36. τὸ ἀντερείδειν (vis inertiae) includes both (1) the tendency of bodies at rest to remain at rest, and (2) the tendency of bodies in motion to continue in motion.

This can be illustrated by a comparison of larger with smaller circles; larger circles can be moved more readily with an exertion of the same amount of force and move other weights with them, because the angle[1] of the larger circle as compared with that of the smaller has an inclination which is in the same proportion as the diameter of the one is to the diameter of the other. Now if any circle be taken, there is always a lesser circle than **852a**
which it is greater; for the lesser circles which can be described are infinite in number.

Now if it is the case that one circle has a greater inclination as compared with another circle, and is correspondingly easy to move, then it is also the case that if a circle does not touch the ground with its circumference, but moves either parallel to the ground[2] or with the motion of a pulley, the circle and the bodies moved by the circle will have a further cause of inclination; for circular objects of this kind move most easily and move weights[3] with them. Can it be that this is due to a reason other than that they have only a very slight contact with the ground, and consequently encounter little friction? This reason is that which we have already mentioned,[4] namely, that the circle is made up of two forms of motion—and so one of them always has an inclination—and those who move a circle move it when it has, as it were, a motion of its own, when they move it at any point on its circumference. They are moving the circumference when it is already in motion; for the motive force pushes it in a tangential direction, while the circle itself moves in the motion which takes place along the diameter.



[1] 851b 38. The angles here compared are those made by the diameters of the two circles and a portion of the circumference. The angle $\alpha\beta\delta$ is greater than the angle $\epsilon\beta\gamma$ in proportion as the diameter $\alpha\beta$ is greater than the diameter $\epsilon\beta$.

[2] 852a 5. e.g. the potter's wheel.

[3] 852a 7. e.g. the pot on the potter's wheel.

[4] Ch. 1.

How is it that we can move objects more easily and 9
quickly when they are lifted or drawn along by circles of large circumference? Why, for example, are large pulleys more effective than small, and similarly large rollers? Is it because the longer the radius is the further the object is moved in the same time, and so it will do the same also with an equal weight upon it?[1] Just as we said[2] that large balances are more accurate than small; for the cord is the centre and the parts of the beam on either side of the cord are the radii.

Why is it that a balance moves more easily without 10
a weight upon it than with one? So too with a wheel or anything of that nature, the smaller and lighter is easier to move than the heavier and larger.[3] Is it because that which is heavy is difficult to move not only vertically, but also horizontally? For one can move[4] a weight with difficulty contrary to its inclination, but easily in the direction of its inclination; and it does not incline in a horizontal direction.

Why is it that it is easier to convey heavy weights on 11
rollers than on carts, though the latter have large wheels and the former a small circumference? Is it because a weight placed upon rollers encounters no friction, whereas when placed upon a cart it has the axle at which it encounters friction? For it presses on the axle from above in addition to the horizontal pressure. But an object on rollers is moved at two points on them, where the ground supports them below and where the weight is imposed above; the circle revolves at both these points and is thrust along as it moves.

Why is it that a missile travels further from a sling than 12
852^{b} from the hand, although he who casts it has more control over the missile in his hand than when he holds the weight

[1] 852^{a} 19. i.e. if the same weight is put on a large roller and upon a small one the large roller will work more quickly.

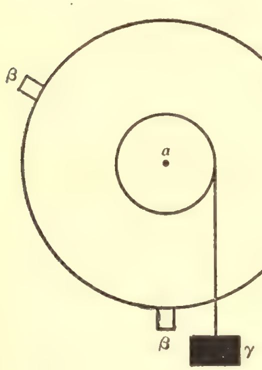
[2] Ch. 1.

[3] Cf. 851^{b} 37 ff.

[4] 852^{a} 28. Reading κινήσει.

suspended? Further, in the latter case he moves two weights, that of the sling and the missile, while in the former case he moves only the missile. Is it because he who casts the missile does so when it is already in motion in the sling (for he swings it round many times before he lets it go), whereas when cast from the hand it starts from a state of rest? Now any object is easier to move when it is already in motion than when it is at rest. Or, while this is one reason, is there a further reason, namely, that in using a sling the hand becomes the centre and the sling the radius, and the longer the radius is the more quickly it moves, and so a cast from the hand is short as compared with a cast from a sling?

13 Why is it that longer bars are moved more easily than shorter ones round the same capstan, and similarly[1] lighter[2] windlasses are moved more easily by the same force than stouter[3] windlasses? Is it because the windlass and the capstan form a centre and the outer masses[4] the radii? For the radii of greater circles are moved more readily and further by the same force than those of lesser circles; for the extremity further from the centre is moved more readily by the same force. Therefore in the case of the capstan they use the bars as a means whereby they turn it more easily; and in the case of the lighter[5] windlasses the part outside the central cylinder is more extended, and this portion forms the radius of the circle.



[1] 852[b] 12. Reading, as suggested by Capelle, *ὡσαύτως* for *οἱ αὐτοί*. *ὄνος* is a windlass or 'wheel and axle' for raising weights. In the figure *α* is the *ξύλον*, round which the rope winds to which the weight *γ* is attached: *β* are handles used to turn the windlass.

[2] i.e. lighter *and broader*.

[3] i.e. stouter *and narrower*.

[4] 852[b] 14. i.e. the rest of the windlass outside the *ξύλον*.

[5] i.e. lighter *and broader*.

Why is it that a piece of wood[1] of the same size is more easily broken against the knee, if one breaks it holding the ends at equal distance from the knee, than if it is held close to the knee? And if one leans a piece of wood upon the ground and places one's foot on it, why does one break it more easily if one grasps it at a distance from the foot rather than near it? Is it because in the former case the knee, and in the latter the foot is the centre, and the further an object is from the centre the more easily is it always moved, and that which is to be broken must be moved? 14

Why is it that the so-called pebbles found on beaches are round, though they are originally formed from stones and shells which are elongated in shape? Is it because objects whose outer surfaces are far removed from their middle point are borne along more quickly by the movements to which they are subjected? The middle of such objects acts as the centre and the distance thence to the exterior becomes the radius, and a longer radius always describes a greater circle than a shorter radius when the force which moves them is equal. An object which traverses a greater space in the same time travels more quickly, and objects which travel more quickly from an equal distance strike harder against other objects, and the more they strike the more they are themselves struck. It follows, therefore, that objects in which the distance from the middle to the exterior is greater always become broken, and in this process they must necessarily become round. So in the
853a case of pebbles, because the sea moves and they move with it, the result is that they are always in motion, and, as they roll about, they come into collision with other objects; and it is their extremities which are necessarily most affected. 15

Why is it that the longer a plank of wood is, the weaker it is, and the more it bends when lifted up? Why, for example, does a short thin plank about two cubits long bend less than a thick plank a hundred cubits long? Is it 16

[1] Reading with Par. B τὸ αὐτὸ μέγεθος ξύλου.

because the length of the plank when it is lifted forms a lever, a weight, and a fulcrum? The first part of it, then, which the hand raises becomes as it were, a fulcrum, and the part towards the end becomes the weight; and so the longer the space is from the fulcrum to the end, the more the plank must bend; for it must necessarily bend more the further away it is from the fulcrum. Therefore the ends of the lever must be subject to pressure.[1] If, then, the lever is bent, it must bend more when it is lifted up. This is exactly what happens in the case of long planks of wood; whereas in the case of shorter planks, the extremity is near the fulcrum which is at rest.

17 How is it that great weights and masses can be split and violent pressure be exerted with a wedge, which is

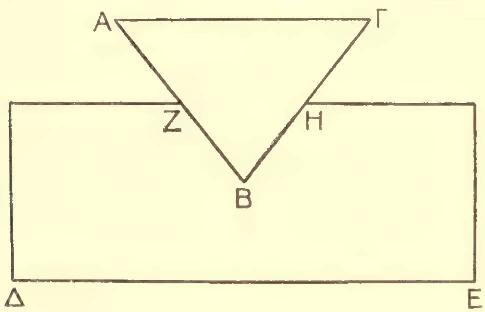


FIG. 9.

a small thing? Is it because the wedge forms two levers working in opposite directions, and each has a weight and fulcrum which presses upwards or downwards? Further, the impetus of the blow causes the weight which strikes the wedge and moves it to be very considerable; and it has all the more force because by reason of its speed it is moving what is already moving. Although the lever is short, great force accompanies it, and so it causes a much more violent movement than we should expect from an estimate of its size. Let ABΓ be the wedge, and ΔEHZ

[1] 853a 15. 'Tenendum scilicet Aristoteli proprium esse verbum αἴρεσθαι (*elevari*) ad motum oneris in vecte indicandum, etiamsi caeteroquin nulla *elevatio*, sed potius contrarius motus, locum habeat' (Capelle). Cf. 854b 6.

the object which is acted upon by it; then AB is a lever and the weight is below at B, and the fulcrum is ZΔ. On the opposite side is the lever BΓ. When AΓ is struck it brings both of these into use as levers; for it presses upwards at the point B.

Why is it that if one puts two pulleys on two blocks which are in opposite positions, and places round them a cord with one end attached to one of the blocks and the other supported by or passed over the pulleys, if one pulls at the end of the cord, one can move great weights, even if the force which draws them is small? Is it because the same weight is raised by less force, if a lever is employed, 18
853b than by the hand, and the pulley acts in the same way as a lever, so that a single pulley will draw more easily and draw a far heavier weight with a slight pull than the hand alone can? Two pulleys raise this weight with more than double the velocity; for the second pulley draws a still less weight than if it drew alone by itself, when the rope is passed on to it from the other pulley: for the other pulley makes the weight still less. Thus if the cord is passed through a greater number, the difference is great, even when there are only a few pulleys, so that, if the load under the first weighs four *minae*, much less is drawn by the last. In building operations they easily move great weights; for they transfer them from one[1] pulley to another and thence again to windlasses and levers, and this is equivalent to constructing a number of pulleys.

How is it that, if you place a heavy axe on a piece of 19
wood and put a heavy weight on the top of it, it does not cleave the wood to any considerable extent, whereas, if you lift the axe and strike the wood with it, it does split it, although the axe when it strikes the blow has much less weight upon it than when it is placed on the wood and pressing on it? Is it because the effect is produced entirely by movement, and that which is heavy gets more movement from its weight when it is in motion than when it is

[1] 853b 11. Reading ἑτέρας for αὐτῆς.

at rest? So when it is merely placed on the wood, it does not move with the movement derived from its weight; but when it is put into motion, it moves with the movement derived from its weight and also with that imparted by the striker. Furthermore, the axe works like a wedge; and a wedge, though small, can split large masses because it is made up of two levers working in opposite directions.

20 Why is it that steelyards[1] weigh great weights of meat with a small counterpoise, the whole forming only a half balance? For a pan is fixed only at the end where the object weighed is placed, and at the other end there is nothing but the steelyard. Is it because the steelyard is at once a beam and a lever? For it is a beam, inasmuch as each position of the cord becomes the centre of the steelyard. Now at one end it has a pan, and at the other instead of a pan the counterpoise which is fixed in the beam, just as if one were to place the other pan with the counterpoise in it at the end of the steelyard; for it is clear that it draws the same weight when it lies in this second pan. But in order that the single beam may act as many beams, many such positions for the cord are situated along a beam of this kind, in each of which the part on the side of the counterpoise forms half the steelyard and acts as the weight,[2] the positions of the cord being moved through equal intervals, so that one can calculate how much weight is drawn by what lies in the pan, and thus know, when the steelyard is horizontal, how much weight the pan holds for each of the several positions of the cord, as has been explained. In short, this may be regarded as a balance, having one pan in which the object weighed is placed, and the other in which is the weight[3] of the steelyard, and so the steelyard at the other end is the counterpoise. And, since it is as described, it acts as an adjustable balance beam, with

[1] 853b 25. The steelyard here described is that now known as the Danish steelyard as distinguished from the common or Roman steelyard.

[2] 853b 39. Punctuating *τὸ ἥμισυ τῆς φάλαγγός ἐστι καὶ ὁ σταθμός, δι' ἴσου κτλ.*, and omitting *τῶν* with Capelle.

[3] 854a 5. Reading *ὁ σταθμός*.

as many forms as there are positions of the cord. And in all cases, when the cord is nearer the pan and the weight upon it, it draws a greater weight, on account of the whole steelyard being an inverted[1] lever (for the cord in each position is a fulcrum, although it is above, and the weight is what is in the pan), and the greater the length of the lever from the fulcrum, the more easily it produces motion in the case of the lever, and in the case of the balance causes equilibrium and counterbalances the weight of the steelyard near the counterpoise.

How is it that dentists extract teeth more easily by 21
applying the additional weight of a tooth-extractor than with the bare hand only? Is it because the tooth is more inclined to slip in the fingers than from the tooth-extractor? or does not the iron slip more than the hand and fail to grasp the tooth all round, since the flesh of the fingers being soft both adheres to and fits round the tooth better? The truth is that the tooth-extractor consists of two levers opposed to one another, with the same fulcrum at the point where the pincers join; so they use the instrument to draw teeth, in order to move them more easily.

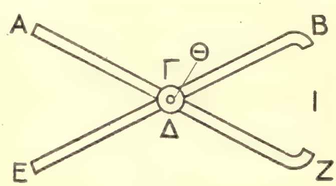


Fig. 10.

Let A be one extremity of the tooth-extractor and B the other extremity which draws the tooth, and AΔZ one lever and BΓE the other, and ΓΘΔ the fulcrum, and let the tooth, which is the weight to be lifted, be at the point I, where the two levers meet. The dentist holds and moves the tooth at the same time with B and Z; and when he has moved it, he can take it out more easily with his fingers than with the instrument.

Why is it that men easily crack nuts, without striking 22

[1] 854a 10. 'Inverted' because the cord is regarded as supporting from above, whereas the fulcrum supports from below; but the cord really supports below, the beam resting on the loop.

a blow upon them, in the instruments made for this purpose? For with nut-crackers much power is lost, namely, that of motion and violent impetus.[1] Further, if one crushes them with a hard and heavy instrument, one can crack them much more quickly than with a light wooden instrument. Is it because the nut is crushed on two of its sides by two levers, and bodies can easily be rent asunder with a lever? For the nut-cracker consists of two levers, with the same fulcrum, namely, A, their point of connexion. As, there- 854b
fore, E and Z would have been easily moved by a small force if they had been pushed apart, so they are easily brought together, the levers being moved at the points Δ and Γ.[2] So EΓ and ZΔ being levers exert the same or even greater force than that which the weight exerted

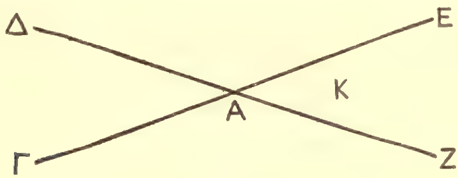


Fig. 11.

when the nut was cracked by a blow; for when weight is put[3] upon the levers they move in opposite directions and compress and break the object at K. For this very reason, too, the nearer K is to A, the sooner it is subjected to pressure; for the further the lever extends from the fulcrum, the more easily and more powerfully does it move an object with the exercise of the same force. A, then, is the fulcrum, and ΔAZ and ΓAE are the levers. The nearer, therefore, K is to the angle at A, the nearer it is to the point where the levers are connected,[4] and this is the fulcrum. So with the same force bringing them together, Z and E must be subjected to more weight;

[1] 854a 34. i.e. the force which would be brought into use if the nut were broken by a blow.
[2] 854b 2. Omitting ὑφ' ὧν, which is clearly corrupt, and placing a comma after ἄκρα.
[3] 854b 5. ἄρσει . . . αἴρονται, see note on 853a 15.
[4] 854b 11. Omitting τῆς A, the reading of Par. B, and probably a gloss: τοῦ of Wa and Par. A was probably a dittography of τοῦτο.

and so, when weight is exerted from two contrary directions, more compression must take place, and the more an object is compressed, the sooner it breaks.

Why is it that in a rhombus, when the points at the **23**
extremities are moved in two movements, they do not describe equal straight lines, but one of them a much longer line than the other? Further (and this is the same question), why does the point [A] moving along the side [AB] describe a resultant line [AΔ] less than the side? For the point describes the diagonal, the shorter distance, and the line [AB] moves along the side [AΓ], the longer distance; and yet the line has but one movement, and the point two movements.[1]

For let A move along AB to B, and B to A with the same velocity; and let the line AB move along AΓ parallel to

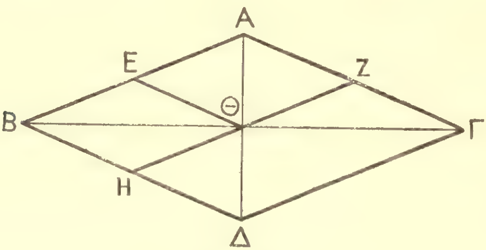


Fig. 12.

ΓΔ with the same velocity. Then the point A must move along the diagonal AΔ, and B along BΓ; and both must describe these diagonals simultaneously, while AB moves along the side AΓ.

For let A be moved the distance AE, and the line AB the distance AZ, and let ZH be drawn parallel to AB, and a line drawn from E to complete the parallelogram [AZΘE]. The small parallelogram then thus formed is similar to the whole parallelogram. Thus AZ equals AE, so that A has been moved along the side AE [to E], while the line AB would be moved the distance AZ. Thus A will be on the diagonal at Θ, and so must always move along the diagonal; and [in the whole parallelogram] the side AB will

[1] 854b 23. This is a special case of the theorem known as the 'parallelogram of velocities'.

describe the side AΓ, and the point A the diagonal AΔ simultaneously. In the same way it may be proved that B moves along the diagonal BΓ, BE being equal to BH. For, if the parallelogram be completed by drawing a line from H, the interior parallelogram [EΘHB] will be similar to the whole parallelogram; and B will be on the diagonal at the point where the sides meet; and the side [BA] will describe 855a
the side [AΓ]; and the point B describes the diagonal BΓ.

At the same time then B will describe a line [BΓ] which is much longer than AB, and the side [AB] will pass along the side [AΓ] which is shorter [than the diagonal], though the velocity is the same, in the same time (and the side [AB] has moved further than A, though it is moved by only one movement). For as the rhombus becomes more acute [at B and Γ], AΔ becomes the lesser diagonal and BΓ greater, and the side [AB] less than BΓ. For it is strange, as has been remarked, that in some cases a point moved by two movements travels more slowly than a point moved by one, and that, while both the given points have equal velocity, either one of them describes a greater line.

The reason is that, when a point moves from an obtuse angle, the sides are in almost opposite directions, namely, that in which the point itself[1] is moved and that in which it is moved down[2] by the side; but when it moves from an acute angle, it moves, as it were, in actual fact towards the same position. For the angle of the sides contributes to increase the speed of the diagonal; and in proportion as one makes the one angle more acute and the other more obtuse, the movement is slower or quicker. For the sides are brought into more opposite direction by the angle becoming more obtuse; but they are brought into the same direction by the sides being brought nearer together. For B moves in practically the same direction in virtue of both its movements; thus one contributes to assist the other, and more so, the more acute the angle becomes. And the reverse is the case with A;

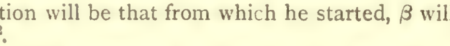
[1] 855a 12. *αὐτό* which is found in Par. B is necessary here, as a point is referred to, and the neuter is always used to signify a point (*σημεῖον*); cf. 854b 23, *τὸ* A and *passim.*

[2] 855a 13. i.e. from the obtuse angle which the author regards as the apex.

for it itself moves towards B, while the movement of the side [AB] brings it down to Δ; and the more obtuse the angle is, the more opposite will the movements be; for the two sides become more like a straight line. If they became actually a straight line, the components would be absolutely in opposite directions. But the side, being moved in one direction only, is interfered with by nothing.[1] In that case it naturally moves through a longer distance.

THERE is a question why a large circle traces out a path **24**
equal to that of a smaller circle, when they are placed about the same centre,[2] but when they are rolled separately,[3] their paths are to one another in the proportion of their dimensions. And, further, the centre of both being one and the same, at one time the path which they trace is of the same length as the smaller traces out alone, and at another time of the length which the larger circle traces.[4] Now it is manifest that the larger circle traces out the longer path. For by mere observation it is plain that the angle which the circumference of each makes with its own diameter is greater in the case of the larger circle than in the smaller;[5] so that, by observation, the paths along
855^b which they roll will have this same proportion to one

[1] 855^a 27. i.e. in the direction of its length. This is an extreme case in which the angle ΓAB (fig. 12) has gradually been made more and more obtuse until ΓA, AB have become merged in ΓB. The whole problem of this chapter may be well illustrated by two men (the points α and β) walking in opposite directions along a barge (the side $\alpha\beta$) drifting at the same velocity. If the barge is drifting in the direction of its own length,



α's final position will be that from which he started, β will have moved from β^1 to β^2.

[2] 855^a 30. Four cases are considered: (1) when the two circles are rolled along a horizontal plane independently, (2) when they are fixed together and rolled along a plane HK, the tangent to the small circle, (3) when they are fixed together and rolled along a plane ZΛ, the tangent to the larger circle, (4) when they have the same centre (or axle), but move independently. Cases (2) and (3) are referred to here.

[3] 855^a 31. i.e. as in case (1).

[4] 855^a 35. i.e. as in cases (2) and (3).

[5] 855^a 36. i.e. the angle AZΓ is greater than the angle AHB, cf. 851^b 38 and note.

another. But, in fact, it is manifest that, when they are situated about the same centre, this is not so, but they trace out an equal path; so that it comes to this, that in the one case the path is equal to that traced by the larger circle, in the other to that traced by the smaller.

Let ΔZΓ be the greater circle, EHB the lesser, A the common centre, ZI the path along which the greater circle moves by its own motion,[1] and HK the path of the smaller circle by its own motion, equal to ZΛ.

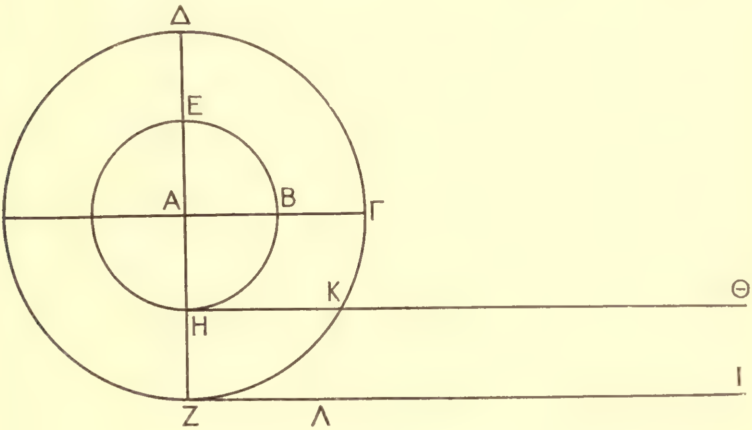


FIG. 13.

When, then, I move the smaller circle,[2] I move the same centre A; and now let the large circle be fixed to it. Whenever, therefore, AB becomes perpendicular to HK [at K], AΓ at the same time becomes perpendicular to ZΛ [at Λ]; so that they will always have traversed an equal distance, HK representing the arc HB, and ZΛ representing the arc ZΓ. And if one quadrant traces an equal path, it is plain that the whole circle will trace out a path equal to that of the other whole circle; so that whenever the line HB comes to K, the arc ZΓ will move along ZΛ; and the same is the case with the whole circle after one revolution.

In like manner if I roll the large circle,[3] fastening the

[1] 855b 9. i.e. motion under the conditions of case (1).
[2] 855b 9. Case (2).
[3] 855b 19. As in case (3).

smaller circle to it, about the same centre, AB will be perpendicular and vertical at the same time as AΓ, the latter to ZI [at I], the former to HΘ [at Θ]. So that, whenever the one [HB] shall have traversed a distance equal to HΘ and the other [ZΓ] a distance equal to ZI, and ZA again becomes perpendicular to ZΛ and AH to HK, they will be in their original position at the points Θ and I. And, since there is no halting of the greater for the lesser, so as to be at rest during an interval at the same point (for in both cases both are moved continuously), nor does the lesser skip any point, it is strange that in one case the greater should traverse a distance equal to that traversed by the lesser, and in the other case the lesser a distance equal to that traversed by the greater. And, further, it is wonderful that, though there is always only one movement, the centre that is moved should be rolled forward in one case a great and in another a less distance. For the same thing moved at the same velocity naturally traverses an equal distance; and to move a thing at the same velocity is to move it an equal distance in both cases.

As to the reason, this may be taken as a principle, that the same, or an equal force, moves one mass more slowly and the other more quickly.

Suppose that there is a body which is not naturally in motion of itself; if another body which is naturally in motion move it and itself as well, it will be moved more slowly than if it were being moved by its own motion alone; and if it be naturally in motion and nothing is moved with it, the same is the case. So it is quite impossible for any body to be moved more than that which moves it; for it is not moved according to any rate of motion of its
856a own, but at the rate of that which moves it.

Let there be two circles, a greater A and a lesser B. If the lesser were to push along the greater, when the greater is not rolling along, it is plain that the greater will traverse so much distance as it has been pushed by the lesser. And it has been pushed the same distance as the small circle has moved; so that they have both traversed an equal straight line. Necessarily, therefore, if the lesser be rolling while it pushes the greater, the latter will be rolled, as well as pushed, just so far as the lesser has been rolled, if the greater have no motion of its own; for in the same way and so far as the moving body moves it, so far must the body which is moved be moved thereby. So, indeed, the lesser[1] circle has moved the greater so far and in such a way,[2] viz., in a circle—say one foot, for let that be the extent of the movement—and consequently the larger circle has moved that distance.

So too, if the large circle move the lesser, the lesser circle will have been moved just as far as the large circle, in whatever way[3] the latter be moved, whether quickly or slowly, by its own motion; and the lesser circle will trace out a line at the same velocity and of the same length as the greater traced out by its natural movement. And this is just what causes the difficulty, that they do not act any longer when they are joined together in the same way as they acted when they were not connected; that is to say, when one is moved by the other not according to its natural motion, nor according to its own motion. For it makes no difference whether one is fixed round the other or fitted inside it, or placed in contact with it; for in all these cases, when one moves and the other is moved by it, the one will be moved just so far as the other moves it.

Now when one moves a circle by means of another circle in contact with it, or suspended from it, one does not revolve it continuously;[4] but if one places them about the same centre, the one must be continuously revolved by the other. But nevertheless, the former is not moved in accordance with its own motion, but just as if it had no proper motion; and if it has a proper motion, but does not make use of it, it comes to the same thing.

Whenever, therefore, the large circle moves the small circle affixed to it, the small circle moves the same distance

[1] 856a 10. Reading with Par. A *κύκλος ὁ μικρός.*
[2] 856a 11. Reading *τοιούτως* for *τὸ αὐτό.*
[3] 856a 15. Reading with Hayduck *ὁποτερωσοῦν* for *ὁποτεροσοῦν*, and placing a comma instead of a full stop after *καὶ ὁ μείζων.*
[4] 856a 24. i.e. the revolutions are not coincident.

as the large, and vice versa. But when they are separate each has its own motion.[1]

If any one raises the difficulty that, when the centre is the same and is moving the two circles with equal velocity, they trace out unequal paths, he is reasoning falsely and sophistically. For the centre is, indeed, the same for both, but only accidentally, just as the same thing may chance to be 'musical' and 'white'; for to be the centre of each of the circles is not the same for it in the two cases.

In conclusion, when it is the smaller circle that moves the greater, the centre and source of motion is to be regarded as belonging to the smaller circle; but when the greater circle moves the lesser, it is to be regarded as belonging to the greater circle. Thus the source of motion is not the same absolutely, though it is in a sense the same.

WHY do they construct beds so that one dimension is 25
856^{b} double the other, one side being six feet long or a little more, the other three feet? And why do they not stretch bed-ropes diagonally? Do they make them of this size so as to fit the body? Thus they have one side twice the length of the other, being four cubits long and two cubits wide.

The ropes are not stretched diagonally but from side to side, so that the wooden frame may be less likely to break; for wood can be cleft most easily if split thus in the natural way,[2] and when there is a pull upon it, it is subject to a considerable strain. Further, since the ropes have to be able to bear a weight, there will be less of a strain when the weight is put upon them if they are strung crosswise rather than diagonally. Again, less rope[3] is used up by this method.

[1] 856^{a} 31. As in case (4), see note on 855^{a} 30.

[2] 856^{b} 8. The scholiast in Par. A explains as follows: 'Pieces of wood are said to be split in the natural way, when the splitting begins from one end; this happens when bed-ropes are attached diagonally.'

[3] 856^{b} 11. *σπάρτον* should probably be read here from W^{a}, meaning the whole rope as opposed to *σπαρτίον*, a piece or section of the rope, l. 6, &c.

Let AZHI be a bed, and let ZH be divided into two equal parts at B. There is an equal number of holes in ZB and ZA; for the sides are equal,[1] each to each, for the whole side ZH is double the side ZA. They stretch the rope on the method already mentioned from A to B, then to Γ, Δ, Θ, and E, and so on until they turn back and reach another angle; for the two ends of the rope [2] come at two different angles.[3]

FIG. 14.

Now the parts of the rope which form the bends are equal, e. g. AB, BΓ are equal to ΓΔ, ΔΘ—and so with other similar pairs of sides, for the same demonstration holds good in all cases.[4] [For AB is equal to EΘ; for the opposite sides of the parallelogram BHKA are equal, and the holes are an equal distance apart from one another. And BH is equal to KA; for the angle at B is equal to the angle at H (for the exterior angle of a parallelogram is equal to the interior opposite angle); and the angle at B is half a right angle, for ZB is equal to ZA, and the angle at Z is a right angle. And the angle at B is equal to the angle at H; for the angle at Z is a right angle, since the bed is a rectangular figure, one side of which is double the other, and

[1] 856^{b} 14. Or rather 'the side and the half-side'.

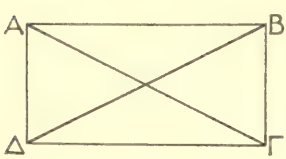
[2] 856^{b} 18. *σπάρτου* should probably be read from the Leid. MS.: see last note.

[3] 856^{b} 11–18. On this passage Apelt comments: 'figuram in re incerta non addidimus.' The above figure is taken from Capelle, who, however, says that it is impossible to work out the whole process of stringing the bed. The author indicates the general method to be adopted, when he says that the rope must be passed from A to B, Γ, Δ, Θ, and that one rope is to be used and that its two ends come at different corners of the bed. The process can be completed by passing the rope from Θ to E, Π, H, K, O, Π, P, Σ, I, B, Γ, P, Σ, N, Λ, Y, M, Δ, Θ, Y, Λ, O, K, Z.

[4] 856^{b} 21–857^{a} 4. The text of the rest of the chapter, which seeks to prove that less rope is required if the bed is strung crosswise than if it is strung diagonally, is absolutely unintelligible as it stands. Capelle comments: 'Haec verba adeo sunt corrupta ut in iis medendis nequicquam omnes commentatores sudarint.' It has therefore seemed best merely to give a translation of the text as it stands with no attempt at emendation.

divided into two equal parts; so that ΒΓ is equal to ΕΗ, as also is ΚΘ; for it is parallel. So that ΒΓ is equal to ΚΘ, and ΓΕ to ΔΘ. In like manner it can be demonstrated that all the other pairs of sides which form the bends of the rope are equal to one another. So that clearly there are four such lengths of rope as AB in the bed; and there is half the number of holes in the half ZB that there is in the whole ZH.[1] So that in the half of the bed there are lengths of rope, such as AB, and they are of the same number as there are holes in BH, or, what comes to the same thing, in AZ, ZB together. But if the rope be strung
857a diagonally, as in the bed ΑΒΓΔ,[2] the halves are not of the same length as the sides of both, AZ and ZH; but they are of the same number[3] as the holes in ZB, ZA. But AZ, ZB, being two, are greater than AB, so that the rope is longer by the amount by which the two sides taken together are greater than the diagonal.]

Why is it more difficult to carry a long plank of wood on **26**
the shoulder if one holds it at the end than if it is held in the middle, though the weight is the same? Is it because, as the plank vibrates, the end prevents one from carrying it, because it tends to interrupt one's progress by its vibration? No, for if it does not bend at all and is not very long, it is nevertheless more difficult to carry if it is held at the end. It is easier to carry if one holds it in the middle rather than at the end, for the same reason for which it is easier to lift in that way. The reason is that, if one lifts it in the middle, the two ends always lighten one another, and one side lifts the other side up. For the middle, where the lifter or carrier holds it, forms, as it were, the centre, and each of the two ends inclining downwards raises up and lightens



[1] 856b 35–857a 4. These lines seem more hopelessly corrupt and unintelligible than those preceding them.

[2] 856b 39. A figure, apparently, in which the rope is strung along the diagonals ΑΓ and ΒΔ and parallel to them on either side.

[3] 857a 2. Reading with Capelle τοσαῦτα for τὰ ἴσα, cf. 856b 36.

the other end; whereas if it is lifted or carried from one end, this effect is not produced, but all the weight inclines in one direction. Let A be the middle of a plank which is raised or carried, and let B and Γ be the extremities. When the plank is lifted or carried at the point A, B inclines downwards and raises Γ up, and Γ inclines downwards and raises B up; the effect is produced by their being raised up at the same moment.

FIG. 15.

27 WHY is a very long object more difficult to carry on the shoulder, even if one carries it in the middle, than a shorter object of the same weight? In the last case we said that the vibration was not the reason; in this case it is the reason. For the longer an object is, the more its extremities vibrate, and so it would be more difficult for the man to carry it. The reason of the increased vibration is that, though the movement is the same, the extremities change their position more the longer the piece of wood is. Let the shoulder, which is the centre (for it is at rest), be at A, and let AB and AΓ be the radii; then the longer the radius AB or AΓ is, the greater is the amplitude of movement. This point has already been demonstrated.[1]

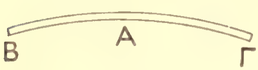


FIG. 16.

28 WHY do they construct 'swipes' by the side of wells by attaching the lead as a weight at the end of the bar, the bucket being itself a weight, whether it is empty or full? Is the reason that, the drawing of water being divided into two operations distinct in time (for the bucket has to be dipped and then drawn up), it is an easy task to let it down when it is empty, but difficult to raise it when it is
full? It is therefore of advantage to lower it rather more 857b
slowly with a view to lightening the weight considerably

[1] Ch. 1.

when it is drawn up again. This effect is produced by the lead or stone attached to the end of the swipe. In letting it down there is a heavier weight to lift than if one has merely to lower the empty bucket; but when it is full, the lead, or whatever the weight attached is, helps to draw it up; and so the two operations taken together are easier than on the other method.

Why is it that when two men are carrying an equal 29
weight on a piece of wood or something of the kind, the pressure on them is not equal unless the weight is in the middle, but it presses more on the person carrying it to whom it is nearest? Is it because the wood, when they hold it in this way, becomes a lever, and the load forms the fulcrum, and the carrier nearer to the load becomes the weight which is to be moved, while the other carrier becomes the mover of the weight? The further the latter is from the weight, the more easily he moves it, and the more he presses down the other man, since the load placed on the wood and acting as a fulcrum, as it were, offers resistance. But if the load is placed in the middle, one carrier does not act as a weight on the other any more than the other on him, or exercise any motive force upon him, but each is equally a weight upon the other.

Why is it that when people rise from a sitting position, 30
they always do so by making an acute angle between the thigh and the lower leg and between the chest and the thigh, otherwise they cannot rise? Is it because equality is always a cause of rest, and a right angle causes an equality[1] and so causes equilibrium? So in rising a man moves towards a position at equal angles to the earth's circumference; for it is not the case that he will actually be at right angles to the ground. Or is it because when a man rises he tends to become upright, and a man who is standing must be perpendicular to the ground? If, then, he is to

[1] 857b 25. i.e. when a line is perpendicular the angles on either side of it are equal.

be at right angles to the ground, that means that he must have his head in the same line as his feet, and this occurs when he is rising. As long, then, as he is sitting, he keeps his feet and head parallel to one another and not in the same straight line. Let A be the head, AB the line of the chest, BΓ the thigh, and ΓΔ the lower leg. Then AB, the line of the chest, is at right angles to the thigh, and the thigh at right angles to the lower leg, when a man is seated in this way. In this position, then, a man cannot rise; but to do so he must bend the leg and place the feet at a point under the head. This will be the case if ΓΔ be moved to ΓZ, and the result will be that he can rise

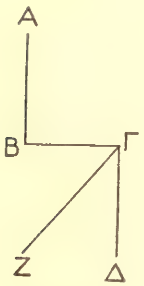


FIG. 17.

immediately, and he will have his head and his feet in 858a
the same straight line;[1] and ΓZ will form an acute angle with BΓ.

31 WHY is it that a body which is already in motion is easier to move than one which is at rest? For example, a wagon which is in motion can be propelled more quickly than one which has to be started. Is it because, in the first place, it is very difficult to move in one direction a weight which is already moving in the opposite direction? For though the motive force may be much quicker, yet some of it is lost; for the propulsion exerted by that which is being pushed in the opposite direction must necessarily become slower. And so, secondly, the propulsion must be slower if the body is at rest; for even that which is at rest offers resistance. When a body is moving in the same direction as that which pushes it, the effect is just as if one increased the force and speed of the motive power; for by moving forward it produces of itself exactly the effect which that power would have upon it.

32 WHY is it that an object which is thrown eventually comes to a standstill? Does it stop when the force which

[1] 858a 1. Reading with Capelle εὐθείας for ἴσης.

started it fails, or because the object is drawn in a contrary direction, or is it due to its downward tendency, which is stronger than the force which threw it? Or is it absurd to discuss such questions, while the principle escapes us?

33 How is it that a body is carried along by a motion not its own, if that which started it does not keep following and pushing it along? Is it not clear that in the beginning the impelling force so acted as to push one thing along, and this in its turn pushes along something else?[1] The moving body comes to a standstill when the force which pushes it along can no longer so act as to push it, and when the weight of the moving object has a stronger inclination downwards than the forward force of that which pushes it.

34 Why is it that neither small nor large bodies travel far when thrown, but they must have due relation to the person who throws them? Is it because that which is thrown or pushed must offer resistance to that from which it is pushed, and whatever does not yield owing to its mass, or does not resist owing to its weakness, does not admit of being thrown or pushed? A body, then, which is far beyond the force which tries to push it, does not yield at all; while that which is far weaker offers no resistance. Or is it because that which travels along does so only as far as it moves the air to its depths, and that which is
858b not moved cannot itself move anything either? Both these things are the case here; that which is very large and that which is very small must be looked upon as not moving at all; for the latter does not move anything, while the former is not itself at all moved.

35 Why is it that an object which is carried round in whirling water is always eventually carried into the middle? Is it because the object has magnitude, so that it has position in two circles, one of its extremities revolving in a greater and the other in a lesser circle? The greater circle, then,

[1] 858a 19. i.e. the air or other medium in which the motion is taking place: cf. below, 30, 31.

on account of its greater velocity, draws it round and thrusts it sideways into the lesser circle; but since the object has breadth, the lesser circle in its turn does the same thing and thrusts it into the next interior circle, until it reaches the centre. Here the object remains because it stands in the same relation to all the circles, being in the middle; for the middle is equidistant from the circumference in the case of each of the circles. Or is it because an object which, owing to its magnitude, the motion of the whirling water cannot overcome, but which by its weight prevails over the velocity of the revolving circle, must necessarily be left behind and travel along more slowly? Now the lesser circle travels more slowly—for the greater and the lesser circle do not[1] revolve over the same space in an equal time when they move round the same centre—and so the object must be left revolving in a lesser and lesser circle until it reaches the middle. If the force of the whirling water prevails at first, it will go on doing so to the end; for one circle must prevail and then the next over the weight of the object owing to their velocity, so that the whole object is continually being left behind in the next circle towards the centre. For an object over which the water does not prevail must be carried either inwards or outwards. Such an object cannot then be carried along in its original position; still less can it be carried along in the outer circle, for the velocity of the outer circle is greater. The only alternative is that the object over which the water does not prevail is transferred to the inner circle. Now every object has a tendency to resist force; but since the arrival at the middle puts an end to motion, and the centre alone is at rest, all objects must necessarily collect there.

[1] 858b 18. Reading with Capelle *οὐ τὸ αὐτὸ γάρ*.

DE LINEIS INSECABILIBUS

BY

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INTRODUCTORY NOTE

THE treatise Περὶ ἀτόμων γραμμῶν, as it is printed in Bekker's Text of Aristotle, is to a large extent unintelligible. But M. Hayduck, in the valuable paper which he contributed to the *Neue Jahrbücher für Philologie und Paedagogik* (vol. 109, part I, Teubner, 1874), prepared the way; and Otto Apelt, profiting by Hayduck's labours and by a fresh collation of the manuscripts, published a more satisfactory text in his volume *Aristotelis quae feruntur de Plantis*, &c. (Teubner, 1888). Many of the most difficult passages are discussed and elucidated in the *prolegomena* to this volume. Finally, Apelt included a German translation of the treatise in his *Beiträge zur Geschichte der griechischen Philosophie* (Teubner, 1891).

In the following paraphrase, I have endeavoured to make a full use of the work of Hayduck and Apelt, with a view to reproducing the subtle and somewhat intricate thought of the author, whoever he may have been. Though the treatise is published amongst the works of Aristotle, there are grounds for ascribing it to Theophrastus: whilst, for all we can tell, it may have been written neither by Aristotle nor by Theophrastus, but by Strato, or possibly by some one otherwise unknown. But the work—no matter who wrote it—is interesting for the close texture of its reasoning, and for the light which it throws on certain obscure places in Plato and Aristotle. Its value for the student of the History of Mathematics is no doubt considerable: but my own ignorance of this subject makes me hesitate to express an opinion.

I take this opportunity of thanking three of my friends, E. I. Carlyle (Fellow of Lincoln College) and A. L. Dixon (Fellow of Merton College) for their help in several of the mathematical passages, and W. D. Ross (Fellow of Oriel College) for his valuable suggestions, most of which I have adopted.

H. H. J.

January, 1908.

ARE there indivisible lines? And, generally, is there a simple unit in every class of quanta?[1]

§ 1. Some people maintain this thesis on the following grounds:—

(i) If we recognize the validity of the predicates 'big' and 'great', we must equally recognize the validity of their opposites, 'little' and 'small'. Now that which admits practically an infinite number of divisions, is 'big' not 'little' ⟨or 'great' not 'small'⟩.[2] Hence, the 'little' quantum and the 'small' quantum will clearly admit only a finite number of divisions.[3] But if the divisions are finite in number, there must be a simple magnitude. Hence in all classes of quanta there will be found a simple unit, since in all of them the predicates 'little' and 'small' apply.

[1] $^{a}1$. *ἐν ἅπασι τοῖς ποσοῖς*, and $^{a}8$ *ἐν ἅπασιν*. The theory maintains that in dividing any quantum, of whatever kind, you will ultimately come to indivisible constituent quanta of the same kind. Every line, e.g., is composed of a finite number of indivisible lines: every solid of a finite number of indivisible solid constituents, i.e. solids not further divisible into solids. The advocates of this theory were feeling after the conception on which the differential calculus was based, and I presume that in the history of Mathematics they would take their place as the forerunners of Newton and Leibniz. Cf. Hegel, *Wissenschaft der Logik*, vol. i. pp. 302–4.

$^{a}2$. *ἔστι τι ἀμερές*. I translate *ἀμερές* throughout by 'simple', using 'simple'—in opposition to 'complex' or 'composite'—as equivalent to 'without parts'.

[2] $^{a}4$ ff. *τὸ πολύ* and *τὸ ὀλίγον*—that which contains many, and that which contains few, units—are the opposite predicates of discrete quanta, i.e. of Number (cf. Arist. *Met.* 992^{a} 16, 17): *τὸ μέγα* and *τὸ μικρόν* apply to continuous quanta. This at least seems to hold of the primary signification of these terms; but the distinction is not maintained. Thus, e.g., in the *Categ.* 4^{b} 20 ff., Number is instanced as a discrete quantum, Time and Surface are quoted *inter alia* as continuous quanta; but *πολύς* is predicated of Surface (5^{b} 2), and of Time (5^{b} 3). I have added ⟨or 'great' not 'small'⟩ in my translation, to complete the writer's thought. I do not suggest that there is an omission in the text.

[3] $^{a}7$. I translate *ἔχει διαιρέσεις* throughout as 'admits divisions', though at times the meaning of the Greek passes into 'contains divisions': cf., e.g., 969^{a} 8.

9 (ii) Again, if there is an Idea of line, and if the Idea is first of the things called by its name[1]:—then, since the parts are by nature prior to their whole, the Ideal Line must be indivisible.[2] And, on the same principle, the Ideal Square, the Ideal Triangle, and all the other Ideal Figures—and, generalizing, the Ideal Plane and the Ideal Solid—must be without parts: for otherwise it will result that there are elements prior to each of them.

14 (iii) Again, if Body consists of elements,[3] and if there is nothing prior to the elements, Fire and, generally, each of the elements which are the constituents of Body must be indivisible: for the parts are prior to their whole. Hence there must be a simple unit in the objects of sense as well as in the objects of thought.[4]

[1] a9, 10. ἡ δ' ἰδέα πρώτη τῶν συνωνύμων, i.e. the Idea is conceived as the limiting member of a series of things called by the same name and sharing the same nature in various degrees. Thus all lines, *quâ* participating in the same linear nature, are called by the same name, 'line.' The Idea of Line is the Ideal Line which exhibits this linear nature perfectly and precisely: it is the limit from which actual lines derive, or to which they more or less approximate. If all lines were arranged in a series according to the degrees in which linearity obtained expression in them, the Idea of Line would be the first member of the series: it would be the Ideal Line which was *just* 'Line', neither more nor less.

[2] a11. I accept Hayduck's conjecture ἀδιαίρετος, for the MSS. διαιρετή, of which I can make nothing.

The theory contemplated by this argument is that in every kind of quantum—and, within spatial quanta, in every type of plane and of solid figure—there is an Ideal Quantum in the sense explained in the preceding note. This Ideal Quantum, it is argued, must be 'indivisible', i.e. simple. For, *quâ* Ideal, it is the primary member in the series of which it is the Idea; but, if it had parts, they would be prior to it, since the parts are prior to their whole.

[3] a14. ἔτι εἰ σώματός ἐστι στοιχεῖα . . . Bekker. Read ἔτι εἰ σώματος ἔστι στοιχεῖα, 'if there are elements of Body.' (The variant σώματα, though well attested, does not seem right.) σῶμα here, as the context shows, is not (as in l. 13) mathematical solid, but perceptible or physical body.

[4] The first two arguments were directed to show that simple units are involved (i) in the Quanta of Mathematics, and (ii) in the Ideal Quanta postulated by a certain metaphysical theory. The present argument is intended to prove that the perceptible bodies (the bodies of Physics and of everyday life) ultimately consist of simple constituents. According to current views, all material things—all αἰσθητὰ σώματα—consisted in the end of certain elementary constituents, viz. Earth, Air, Fire, and Water. An 'Element' means what is primordial, and therefore (it is argued) it must be without parts.

The writer does not explain to what precise form of physical theory he is alluding. He seems to be thinking of the somewhat vague and

(iv) Again, Zeno's argument proves that there must be simple magnitudes.[1] For the body, which is moving along a line, must reach the half-way point before it reaches the end. And since there always is a half-way point in any 'stretch' which is not simple, motion—unless there be simple magnitudes—involves that the moving body touches successively one-by-one an infinite number of points in a finite time: which is impossible.[2]

But even if the body, which is moving along the line, does touch the infinity of points in a finite time, an absurdity results. For since the quicker the movement of the moving body, the greater the 'stretch' which it traverses in an equal time: and since the movement of thought is quickest of all movements:—it follows that thought too will come successively into contact with an infinity of objects in a finite time. 968b
And since 'thought's coming into contact with objects one-by-one' is counting, we must admit that it is possible to count the units of an infinite sum in a finite time. But since this is impossible, there must be such a thing as an 'indivisible line'.[3]

popular view, which regarded Earth, Air, Fire, and Water as the 'Letters' of the Alphabet of Reality, and the physical universe as a complex of 'Syllables' and 'Words' in which these four Letters are variously combined. But the *principle* of the argument would apply to the more refined forms which the theory assumes in the *Timaeus* of Plato and in Aristotle's physical writings. The primordial triangles of the *Timaeus*, *quâ* Elements of all bodies, are presumably without physical parts, i.e. physically indivisible. And the Earth, Air, Fire, and Water, which (according to Aristotle) are the chemical constituents of all ὁμοιομερῆ—and therefore the primary constituents of all composite bodies—, are 'τὰ ἁπλᾶ σώματα', although the character of each of them is dual, i.e. is exhibited in two of the four fundamental qualities. (For Aristotle's theory of the Elements, cf. my article on 'Aristotle's Conception of Chemical Combination', *Journal of Philology*, No. 57.)

[1] a19. *ἀνάγκη τι μέγεθος ἀμερὲς εἶναι*, i.e. there must be *such a thing as* a simple magnitude. For Zeno's argument cf. Arist. *Phys.* 187a 1 and Simplicius *ad loc.*

[2] a18–23. Here and elsewhere I have not scrupled to paraphrase rather freely, in order to bring out the argument. From the infinite divisibility of the continuous path of the moving body, Zeno concluded that motion was impossible; for the moving body would have to come successively into contact with an infinite number of points in a finite time. The advocates of 'simple units' argue that, *since motion is a fact*, the continuous path cannot be divisible *ad infinitum*: i.e. any given line must consist of a finite number of 'indivisible lines'.

[3] b4. The Greek is *εἴη ἄν τις ἄτομος γραμμή*. The meaning here (as in

(v) Again, the being of 'indivisible lines' (it is maintained) follows from the Mathematicians' own statements. For if we accept their definition of 'commensurate' lines as those which are measured by the same unit of measurement,[1] and if we suppose that all commensurate lines actually are being measured,[2] there will be some actual length, by which all of them will be measured.[3] And this length must be indivisible. For if it is divisible, its parts—since they are commensurate with the whole—will involve some unit of measurement measuring both them and their whole. And thus the original

968^b 5: cf. also 968^a 19) cannot be given by the English 'there must be an indivisible line' or 'a line which is indivisible'. We must translate either as above, or by the plural 'there must be indivisible lines'.

The argument ($^a23$–$^b4$) is directed against a particular view of thought and of counting. 'Assume'—the writer says in effect—'that the moving body does in fact touch an infinity of points one-by-one in a finite time. According to your view that thought is the quickest of all movements, it will follow *a fortiori* that thought touches an infinity of objects one-by-one in a finite time: i.e. (according to your definition of counting) that we can count an infinite number in a finite time. But this is impossible. And the only way to avoid this absurdity, *whilst recognizing the fact of motion*, is to postulate "indivisible lines".'

The theory that thinking is a movement of the Soul was not held by Aristotle: for he argues in the *de Anima* (A. ch. 3) against all attempts to define the Soul as 'that which moves itself,' and maintains that 'it is impossible that movement should be a property of the Soul' (l. c. 406^a 2 ff.). Certain speculations of Plato in the *Timaeus* (which Aristotle criticizes, l. c. 406^b 26 ff.) regard thought as a movement: and Theophrastus and his pupil, Strato, are known to have maintained that thought was a movement of the Soul (cf. Apelt, *Beiträge* &c., p. 270). But we must not infer—as Apelt (l. c.) does—that Aristotle is not the author of the present treatise: still less that it was written by Theophrastus or Strato. For we are here dealing with an *argumentum ad hominem*, and the writer is not himself committed to the view that thought is a movement of the Soul.

[1] Cf. Euclid, *Elements*, Bk. X, def. i Σύμμετρα μεγέθη λέγεται τὰ τῷ αὐτῷ μέτρῳ μετρούμενα, ...

[2] $^b6$, 7, reading (with all the MSS., except N) εἰ σύμμετροί εἰσιν αἱ τῷ αὐτῷ μέτρῳ μετρούμεναι, ὅσαι δ' εἰσὶ σύμμετροι, πᾶσαί εἰσι μετρούμεναι.

Apelt *in his text* followed N, and read ὅσαι δ' εἰσὶ μετρούμεναι, πᾶσαί εἰσι σύμμετροι. But *in his translation* he reverts to the best attested reading.

I substitute a comma for Bekker's colon after μετρούμεναι in l. 6, because the whole clause is dependent on εἰ. The logic of the passage is, 'If we accept x, and combine with that the supposition y, there must be indivisible lines: for *on those suppositions* there will be a unit length which must be indivisible.'

[3] $^b8$. ᾧ πᾶσαι μετρηθήσονται, 'whereby all *commensurate* lines will be measured': but, as appears from 969^b 10–12, the argument (by a somewhat transparent fallacy) regarded *all lines* as 'commensurate'. See next note.

unit of measurement would turn out to be twice one of its parts, viz. twice its half.[1] But since this is impossible, there must be an indivisible unit of measurement.[2] And just as all the lines, which are compounded of the unit, are composed of 'simples', so also the lines, which the unit measures once, consist of 'simples'.[3]

And the same can be shown to follow in the plane figures too. For all the squares, which are drawn on the rational lines, are commensurate with one another; and therefore ⟨by the preceding argument⟩ their unit of measurement will be simple.[4]

[1] ^{b}10, 11. Bekker reads *ὥστε μέρους τινὸς εἴη* [*εἶναι* W^a] *διπλασία* [*διπλασίαν* rc N, *διπλάσιον* LW^a] *τὴν ἡμίσειαν*, . . . From the reading of LW^a, I suspect that the author wrote *διπλασίων* (cf. e.g. Euclid, *Elements*, Bk. X, prop. 9: the word occurs in [Arist.] *Probl.* 923^a 3, *De Mundo*, 399^a 9). In place of *τὴν ἡμίσειαν*, Z^a apparently ('ut videtur', Apelt says in his *apparatus criticus*) reads *τῆς ἡμίσυος*. Hayduck conjectured *ὥστε μέτρον ἂν εἴη διπλασία τῆς ἡμισείας*, or *ὥστε μετρεῖν ἂν εἴη διπλασίᾳ τὴν ἡμίσειαν*. Apelt suggests *ὥστε μέρους τινὸς ἂν εἶναι διπλασίαν τὴν ἡμίσειαν*, but I do not see that this is of much assistance. I have translated as if the text were *ὥστε μέρους τινὸς ⟨ἂν⟩ εἴη διπλασίων, τῆς ἡμισέας· ἐπεὶ δὲ κτλ.* But it is possible that *τῆς ἡμισέας* ought to be excised as a gloss explanatory of *μέρους τινός*.

It appears (from the criticism of this argument at 969^b 10–12) that the advocates of 'indivisible lines' reasoned thus:—'Lines measured by the same unit are "commensurate". Now take any line, *AB*. It will always be possible to find, or draw, a line containing without remainder a multiple of the units in *AB*: i.e. *AB* will be "commensurate". Let then all "commensurate" lines (i.e. *all lines*) be actually measured. There will be an actual length, or infinitesimal line, *xy*, which is the unit of measurement of them all. And *xy* must be indivisible. For, if not, *xy* will have parts: and thus the unit will be multiple (v.g. will be twice its own half), which is absurd.' The fallacy is obvious, and is exposed at 969^b 10–12. Any line *AB* can become 'commensurate' with *some* line: but, because commensurate with *some* line, it is not necessarily commensurate with *all* lines, or 'commensurate' absolutely. One would indeed think the fallacy too obvious to have been committed: but, in the refutation, the writer refers to it as a ridiculous and obvious sophism, cf. 969^b 6–10 and 12–15.

[2] ^{b}11. The MSS. read *ἡμίσειαν, ἐπειδὴ τοῦτ' ἀδύνατον ἂν εἴη μέτρον.*
I read with Apelt *ἐπεὶ δὲ τοῦτ' ἀδύνατον, ⟨ἀδιαίρετον⟩ ἂν εἴη μέτρον*, and place a colon before *ἐπεί*. The insertion of *ἀδιαίρετον* was suggested by Hayduck, after the Latin translator, Julius Martianus Rota, who writes 'quoniam vero hoc fieri nequit, indivisibilis esse mensura debet'.

[3] ^{b}12–14. Let *xy* be the unit of measurement, which measures all commensurate (i.e. *all*) lines. Then all lines will 'consist' of simples: for they will either contain *xy* once, or more than once, without remainder.

[4] ^{b}14–16. The object of this argument is to show that 'simple units' must be admitted in plane figures, as well as in lines. The writer selects the square as an example of plane figure, and maintains that all squares

16 But if ⟨*per impossibile*⟩ any such unit-square be cut along any prescribed and determinate line, that line will be neither 'rational' nor 'irrational', nor any of the recognized kinds of ⟨irrational⟩ lines which produce rational squares, such as the 'apotome' or the 'line ex duobus nominibus'. Such lines, 20 at which the unit-square might be divided, will have no nature of their own at all; though, relatively to one another, they will be rational or irrational.[1]

consist ultimately of a finite number of minimal squares, not themselves divisible into any smaller plane figures.

In order to understand the argument, and the fallacy on which it rests, it will be necessary to explain certain technical terms of Greek geometry. (1) The expression τὰ ἀπὸ τῶν ῥητῶν γραμμῶν (l. 15) must—in accordance with Euclid's invariable usage—mean 'the squares on the ῥηταὶ γραμμαί'. The noun implied is τετράγωνα: but τὸ ἀπό followed by the genitive is constantly used without τετράγωνον, and always means the square on such-and-such a line. (Hence Apelt is wrong in translating 'Alle *Flächen* mit rationalen Seitenlinien'.) (2) The proper meaning of ῥηταὶ γραμμαί will be seen from the following definitions of Euclid (*Elem.* X):—def. 3 '... given any straight line, there are an infinity of straight lines commensurate with it and an infinity incommensurate with it—incommensurate *either* in length only, *or* both in length and in respect to the areas which they and it produce if squared (αἱ μὲν μήκει μόνον, αἱ δὲ καὶ δυνάμει: see below). Let the given straight line, and all the straight lines which are commensurate with it (whether commensurate both μήκει and δυνάμει, or δυνάμει only), be called "Rational" (ῥηταί): and let the straight lines, which are incommensurate with it, be called "Irrational" (ἄλογοι)': def. 4 'And let the square on the given straight line, and all the squares commensurate therewith, be called "Rational": and let the squares incommensurate with it be called "Irrational" . . .' (3) Any straight lines, which are multiples of the same unit of length, are said to be σύμμετροι μήκει. If e.g. the unit of measurement be ἡ ποδιαία (the line one foot long), all lines containing a whole number of feet are σύμμετροι μήκει. But lines which do not contain a whole number of the same unit of length are said to be σύμμετροι δυνάμει, if they form squares containing a whole number of the same unit of area. All lines, which are σύμμετροι μήκει, are necessarily also σύμμετροι δυνάμει—but the converse does not hold (Eucl. *Elem.* X, prop. 9, Coroll.).

We are now in a position to understand the argument of b14–16. The writer extends the relative term 'rational' illegitimately (making it absolute), just as before he illegitimately extended the relative term 'commensurate'. All 'rational' lines are by definition δυνάμει σύμμετροι: and therefore all squares on rational lines are commensurate. And if we suppose them actually measured, there will be an actual minimal square, the unit of measurement of them all (cf. above, 968b 6–8): and this minimal square can be shown to be indivisible—i.e. not to contain smaller plane figures—as before the unit-line was shown to be ἀδιαίρετον (968b 8–12). But—*unless we assume that all lines consist of indivisible and equal unit-lines*—we cannot assume that *all* lines are 'rational' in Euclid's sense, nor that *all* squares are commensurate with one another.

[1] b16–21. The text of this passage is corrupt, and the argument obscure, and I have no confidence in the interpretation which I have given. As

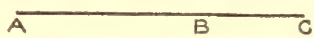
§ 2. To these arguments we must make the following 21
answers:—

(i) (a) In the first place, it does not follow that the quantum, which admits an infinite number of divisions, is not 'small' or 'little'. For we apply the predicate 'small' to place and magnitude, and generally to the continuous (and in some quanta the predicate 'little' is suitably applied)[1]; and nevertheless

regards the text, I adopt Apelt's reading in l. 19, ὧν δυνάμεις ῥηταί, οἷον ἀποτομὴ ἢ ἡ ἐκ δυοῖν ὀνομάτοιν for the MSS. ὧν δὴ νῦν [νῦν δὴ N] εἴρηται, οἷον ἀποτομὴν ἐκ δυοῖν ὀνομάτοιν.

The lines called ἐκ δυοῖν ὀνομάτοιν and ἀποτομή are two types of Irrationals (i.e. μήκει ἀσύμμετροι, but δυνάμει σύμμετροι) which play a large part in Euclid, *Elem.* Bk. X.

The line ἐκ δυοῖν ὀνομάτοιν is defined in Prop. 36 thus:—'If two rational straight lines, which are commensurate δυνάμει only, be added together, the whole line is irrational: let it be called "the line ἐκ δύο ὀνομάτων"':—i.e. the line AC is that type of 'Irrational' (irrational relatively to AB and BC) which is called 'ex duobus nominibus', if it is such, that AB^2 is commensurate with BC^2, but AB is incommensurate with BC. AB and BC are called the 'ὀνόματα' of AC.



The ἀποτομή is defined in Prop. 73 thus:—'If from a rational line there be taken a rational line commensurate with the whole line δυνάμει only, the remainder is irrational: let it be called an "ἀποτομή"':—i.e. if the line AB be divided at C, so that AB^2 is commensurate with CB^2 but AB is incommensurate (μήκει) with CB, then AC is called an ἀποτομή. The complementary part of the whole line (viz. CB) is called relatively to AC its προσαρμόζουσα (cf. Propp. 79–84).

We might illustrate these two types of 'Irrationals' thus:—(1) Let the two ὀνόματα be 1 and $\sqrt{5}$. Then the whole line, $AB+BC,=(1+\sqrt{5})$. 1 is incommensurate with $\sqrt{5}$, but $(1)^2$ and $(\sqrt{5})^2$ are commensurate. (2) Let the whole line, AB, be $\sqrt{5}$. Divide AB at C, so that $CB=1$. Then $(\sqrt{5})^2$ is commensurate with $(1)^2$, but $\sqrt{5}$ is incommensurate with 1. AC (the ἀποτομή) $=(\sqrt{5}-1)$.

I have interpreted the argument (968b 16–21) as a *reductio ad absurdum.* 'Suppose,' the writer urges, 'the unit-square is divided. The line dividing it will not answer to any known line: i.e. there is no line recognized by Geometry at which the unit-square could be divided into smaller plane figures. For whatever line of division be selected, that line will neither be rational nor irrational: nor will it fall under any of the recognized types of line which, though irrational *quâ* lines, produce rational squares, or otherwise exhibit relations studied by Geometry. Any such lines of division will, in fact, belong to a new order of lines, which may be expressed as rational or irrational in terms of one another, but not in terms of the ordinary geometry of lines.'

[1] b24. καὶ ἐφ' ὧν μὲν ἁρμόττει τὸ ὀλίγον . . .

Hayduck suggested καὶ ἐφ' ὧν ἁρμόττει, ὀλίγον, which would be an improvement, though the excision of μέν seems unnecessary. (It is, we affirm that these quanta admit an infinite number of divisions.

(i) (b) Moreover, if in the composite magnitude there are contained ⟨indivisible⟩ lines,[1] the predicate 'small' is applied to these indivisible lines, and each of them contains an infinite

969a number of points. But each of them, *quâ* line, admits of division at a point, and equally at any and every point: hence each of these indivisible lines would admit an infinite number of divisions just like the non-indivisible lines.[2] Moreover, some amongst the non-indivisible lines are 'small'. But every non-indivisible line admits of division in accordance with any prescribed ratio: and the ratios, ⟨in accordance with which any such line may be divided⟩, are infinite in number.[3]

however, omitted by Z^a.) Apelt defends the MSS. reading, but interprets *καὶ ἐφ' ὧν—ὀλίγον* as part of the subject of the sentence, taking *μικρόν* as predicate of the whole. This seems difficult, because (*a*) the *μὲν* [*ἐφ' ὧν μὲν*] is purely gratuitous, and (*b*) there is no reason why the writer should over-ride the distinction between *μικρόν* and *ὀλίγον*.

If the *τό* be retained, the clause must, I think, be treated as parenthetical and interpreted as above.

[1] ^{b}25. Apelt reads (with N) *ἔτι δ' εἰ ἐν τοῖς συμμέτροις γραμμαί εἰσι γραμμαί.* He suggests that the passage ought to be emended to run *ἔτι δ' εἰ ἐνίαις σύμμετροι γραμμαῖς εἰσὶ γραμμαί, κατὰ τούτων ἄτομον λέγεται τὸ μικρόν.* Of this I can make nothing: nor do I see how he could defend his translation 'und von ihrem Mass gesagt wird, es sei unteilbar klein'.

All the MSS. (except N and Z^a) read *ἔτι δ' εἰ ἐν τῷ συνθέτῳ γραμμαί, κατὰ τούτων τῶν* [*τῶν* omit t. NPW^aZ^a] *ἀτόμων κτλ.* But as in PW^a and L there is a lacuna after *συνθέτῳ*, I have ventured to conjecture *ἔτι δ' εἰ ἐν τῷ συνθέτῳ ⟨ἄτομοί εἰσι⟩ γραμμαί* . . . With *συνθέτῳ* I understand *μεγέθει* or *μήκει.*

[2] ^{a}2, 3. The text in Bekker is *καὶ ὁμοίως καθ' ὁποιανοῦν ἀπείρους ἂν ἔχοι διαιρέσεις ἅπασα ἡ μὴ ἄτομος.* I follow Apelt in placing a colon after *ὁποιανοῦν*, and in reading *ἀπείρους οὖν ἔχοι* . . . After *ἅπασα* I insert *ἄν, ὡς*, combining the readings of NZ^a and H^a. The passage then runs *καθ' ὁποιανοῦν· ἀπείρους οὖν ἔχοι διαιρέσεις ἅπασα ἄν, ὡς ἡ μὴ ἄτομος.*

[3] ^{a}3–5. The text given in Bekker is *ἔνιαι δὲ τούτων εἰς μακρὰ* [*μικρὰ* LZ^a, *μικρὰν* NH^a] *καὶ ἄπειροι οἱ λόγοι* [for *οἱ λόγοι* LPH^aW^a read *ὀλίγον*, Z^a reads *καὶ ὀλίγον*]. *πᾶσαν δὲ τμηθῆναι τὸν ἐπιταχθέντα δυνατὸν τὴν μὴ ἄτομον.* [For *τὴν μή* H^a reads *τομὴν τήν*, and N places *τὸν ἐπιταχθέντα* after *ἄτομον*.]

I have ventured to read *ἔνιαι δὲ τούτων εἰσὶ μικραί· πᾶσαν δὲ τμηθῆναι δυνατὸν τὴν μὴ ἄτομον τὸν* [? *κατὰ τὸν*] *ἐπιταχθέντα λόγον· καὶ ἄπειροι οἱ λόγοι.* If this be thought too bold, we might retain the MSS. order, and read *ἔνιαι . . . μικραί· καὶ ἄπειροι οἱ λόγοι, πᾶσαν . . . τὴν μὴ ἄτομον τὸν ἐπιταχθέντα.* We must then take *καὶ ἄπειροι οἱ λόγοι* closely with the following words. The only authority for *λόγον* (which Apelt inserts after *ἐπιταχθέντα*) is the *editio princeps.*

(i) (c) Again, since the 'great' is compounded of certain 'smalls', the 'great' will either be nothing, or it will be identical with that which admits a finite number of divisions.[1] For the whole admits the divisions admitted by its parts: i.e. *its* divisions are finite or infinite, according as *their* divisions are finite or infinite.[2] It is unreasonable that, whilst the small admits a finite number of divisions only, the great should admit an infinite number; and yet this is what the advocates of the theory postulate.[3]

It is clear, therefore, that it is not *quâ* admitting a finite and an infinite number of divisions that quanta are called 'small' and 'great' respectively. And to argue that, because *in numbers* the 'little' number admits a finite number of divisions, therefore *in lines* the 'small' line must admit only a finite number of divisions, is childish. For in numbers the more complex are developed out of 'simples', and there is a determinate something from which the whole series of the numbers starts, and every number which is not infinite admits

The argument of the whole passage (968^b 25–969^a 5) I take to be as follows:—'Every composite length contains lines. According to the theory, some amongst these lines are "indivisible". But every one of these lines, *quâ* line, contains an infinity of points, and admits therefore an infinity of divisions: for a point is that at which a line can be divided. Yet by comparison with the whole (composite) length, all the "indivisible" lines, and at least *some* of the divisible lines, are "small". Hence infinitely-divisible quanta may be "small".'

The λόγοι (969^a 4) are, I presume, the numerical ratios in which any line may be divided.

[1] ^{a}7. I accept Apelt's conjecture τὸ μέγα for the MSS. οὐ μέγα.

[2] ^{a}8. τὸ γὰρ ὅλον τὰς τῶν μερῶν ἔχει διαιρέσεις ὁμοίως, i. e. the divisions which the whole admits—since it is the sum of its parts—are the sum of the divisions which the parts admit, and the number of divisions is either finite or infinite *in both cases*. The argument, to which this is a reply, assumed that the large number of divisions in the 'great' was 'practically infinite' (968^a 4), whilst the 'small' admitted only a finite number of divisions.

[3] Reading, with Apelt, ἄλογον (for the MSS. εὔλογον) in ^{a}8, and οὕτω δ' ἀξιοῦσιν (for the MSS. οὕτως ἀξιοῦσιν) in ^{a}10.

It is just possible, however, to retain the MSS. reading, if we construe ἀξιοῦσιν as dative plural of the participle, and remove the stop before οὕτως. 'And yet it is a reasonable inference for them, with their assumptions, that the "small" admits a finite number, and the "great" an infinite number, of divisions':—i. e. the view in question has just been shown to be false, but it follows plausibly enough from their premisses.

a finite number of divisions; but in magnitudes the case is not parallel.[1]

17 (ii) As to those who try to establish the being of the indivisible lines by arguments drawn from the Ideal Lines, we may perhaps say that, in positing Ideas of these quanta, they are assuming a premiss too narrow to carry their conclusion; and, by arguing thus, they in a sense destroy the premisses which they use to prove their conclusion. For their arguments destroy the Ideas.[2]

21 (iii) Again, as to the corporeal elements,[3] it is childish to postulate them as 'simple'. For even though some physicists do as a matter of fact make this statement about them, yet to assume this for the present inquiry[4] is a *petitio principii*. Or rather, the more obviously the argument would appear to involve a *petitio principii*, the more the opinion is confirmed that Solids and Lengths[5] are divisible in bulk and distance.[6]

[1] The above arguments, from 968b 21, are directed against the first argument (968a 2–9) of the advocates of indivisible lines.

[2] a17–21. This is directed against the second argument (968a 9–14) of the advocates of indivisible lines.

κατασκευάζω is used in the sense of 'establishing' (e. g. a conclusion or a definition) in opposition to *ἀνασκευάζω*, 'to overturn': cf. e.g. *Pr. Anal.* 43a 1, *Top.* 102a 15, &c. The argument in question aimed at proving the universal affirmative that *all* lines contain indivisible lines as ultimate constituents. And it tried to base this conclusion on the indivisibility of the Idea of line, i. e. it involved the assumption of Ideas of quanta, or at least of Ideas of lines. But from what holds good of Ideal lines, you can make no valid inference to *all* lines: the premiss is particular (Ideal Lines, i. e. *some* lines, are indivisible), and cannot serve as the basis of the universal conclusion which is to be proved.

Moreover, it is dangerous for the advocates of Ideas to use an argument of this kind. For their opponents may retort that, if the assumption of Ideal quanta leads to the absurdity of indivisible lines, then *so much the worse* for the Ideal theory. In the sphere of mathematics, they may say, the assumption leads to consequences mathematically absurd; hence the whole theory of Ideas is discredited.

[3] a21. *πάλιν δὲ τῶν σωματικῶν στοιχείων* . . . The genitive alone seems impossible. I read *πάλιν δ' ἐπὶ τῶν κτλ.* (coll. 969b 6).

[4] a23. *πρός γε τὴν ὑποκειμένην σκέψιν* . . . I can find no exact parallel to this use of *ὑποκειμένην*, but cf. perhaps *Pol.* 1331b 36. In the next two lines *ὅσῳ μᾶλλον . . . τόσῳ μᾶλλον* is an expression without parallel in Aristotle.

[5] a26. Reading *σῶμα καὶ μῆκος*, and interpreting *σῶμα* as 'geometrical solid' (not as 'perceptible body'). The difficulty in this reading is that *καὶ τοῖς ὄγκοις καὶ τοῖς διαστήμασιν* ought to mean 'both in bulk and distance': but this would be true of *σῶμα* only. *Disjunctively*, of course, it is true of *σῶμα* and *μῆκος*, but the double *καί* is certainly awkward. Apelt in his translation adopts the reading of LNHaWa *σῶμα μήκους*: but he

(iv) The argument of Zeno does not establish that the moving body comes into contact with the infinite number of points in a finite time, if the period and the path of the motion are considered on the same principle.[1] For the time and the length are called ⟨both⟩ infinite and finite ⟨from different points of view⟩, and admit of the same divisions ⟨if considered both on the same principle⟩.[2]

Nor is 'thought's coming into contact with the members of an infinite series one-by-one' *counting*, even if it were supposed that thought does 'come into contact' in this way with the members of an infinite series. Such a supposition perhaps assumes what is impossible: for the movement of thought does not, like the movement of moving bodies, essentially involve *continua* and *substrata*. 969b

If, however, the possibility of thought moving in this fashion be admitted, still this moving is not 'counting'; for counting is movement combined with pausing.

It is absurd—we may perhaps suggest to our opponents—

can only translate this by making the μᾶλλον of l. 25 do double duty. All would be plain if we could omit καὶ μῆκος altogether, and read σῶμα [i. e. 'perceptible body'] καὶ τ. ὄγκοις κ. τ. διαστήμασιν.

[6] a21–26. This paragraph is directed against the third argument (968a 14–18) of the advocates of indivisible lines. That argument rested on the assumption that perceptible bodies involved Elements, i. e. *primary* constituents. Even admitting that some physicists speak in this way about the constituents of bodies, to take this as a premiss to prove that there are indivisible magnitudes is to beg the question. (Cf. Hayduck, l. c., p. 163, for the above interpretation.) Or at least it looks like begging the question: and the more it looks so, the more the prevailing opposite opinion is confirmed. For a view gathers strength in proportion to the weakness of the arguments advanced against it.

[1] a27, 28. The MSS. read . . . . συμβιβάζει οὐ συμπεπερασμένῳ χρόνῳ τῶν ἀπείρων ἅπτεται [LNPW^{a}Z^a: ἅπτεσθαι *ceteri*] τὸ φερόμενον ὡδὶ τὸν αὐτὸν τρόπον.

Bonitz conjectured τὸ ἐν πεπερασμένῳ χρόνῳ . . . ἅπτεσθαι. I read with Apelt ὡς ἐν πεπερασμένῳ . . . ἅπτεται. And in l. 30 I accept Apelt's τὰς αὐτὰς ἔχει διαιρέσεις (for which he compares Arist. *Phys.* 235a 15) for the MSS. τόσας, or τοσαύτας, ἔχει διαιρέσεις.

[2] a26–30. The period and the path of the motion, *quâ* continuous quanta, are divisible *ad infinitum*: but, *quâ* determinate (finite), may both be regarded as containing a finite number of units, i.e. as admitting a finite number of divisions only. Zeno's argument depends on the fallacy of viewing the period as finite, and neglecting its divisibility *ad infinitum quâ* continuous: whilst the path is viewed (*quâ* continuous) as an actual infinity of points, and its finiteness is neglected. [Cf. also Aristotle's solution of Zeno's argument, *Phys.* 233a 8–34.]

that, because you are unable to solve Zeno's argument, you should make yourselves slaves of your inability, and should commit yourselves to still greater errors, in the endeavour to support your incompetence.[1]

6 (v) As to what they say about 'commensurate lines'—that all lines, because commensurate [2], are measured by one and the same actual unit of measurement—this is sheer sophistry; nor is it in the least in accordance with the mathematical assumption as to commensurability. For the mathematicians do not make the assumption in this form, nor is it of any use to them.

10 Moreover, it is actually [3] inconsistent to postulate both that every line becomes commensurate, and that there is a common measure of all commensurate lines.[4]

[1] This and the preceding argument are directed against the fourth argument (968a 18–b4) of the advocates of indivisible lines.

The writer urges (i) that Zeno's argument involves a fallacy, which the advocates of indivisible lines have failed to detect (969a 26–30). (ii) That the movement of thought ('psychical process') is not analogous to the movement of a body. The latter is essentially conditioned by the continuity of the path traversed and the continuity of the body moving: for physical movement takes place in a material *substratum*—i.e. a solid material body—and along a path in space. (iii) That if the movement of thought were analogous to the movement of a body, more than this would be required to constitute 'counting'. For to 'count' is not merely to traverse a continuous path, coming into instantaneous contact with the infinite succession of points, into which that path may be mathematically resolved: to 'count' essentially involves *pausing* at the successive steps of the process. (iv) That the argument drawn from 'counting' is an extravagant supposition by which the advocates of 'indivisible lines' are endeavouring to support themselves in an erroneous position—a position really due to their incompetence in failing to detect Zeno's fallacy.

[2] b7. The MSS. read *ὡς ὅτι αἱ πᾶσαι*. This presumably means 'e.g. that' or 'viz. that'. But it is very doubtful whether *ὡς ὅτι* could be used in this way as equivalent to the ordinary *οἷον ὅτι*. I propose to read *ὡς, ὅτι ⟨σύμμετροι⟩, αἱ πᾶσαι . . . .*

[3] **καὶ ἐναντίον.**

[4] b6–12. This is directed against the fifth argument of the advocates of indivisible lines (cf. above, 968b 4–14).

It is difficult to be sure of the meaning of 969b 10–12, owing to the obscurity of the argument which is being attacked. I think the point of the criticism is as follows. The mathematical definition of commensurate lines can always be satisfied, in the sense that, given any line *AB*, you can always find a line 'commensurate' with it: i.e. any line can become 'commensurate' with *some* line. But though *all* lines are 'commensurate' in this sense, they are not all commensurate *with one another*, and have not got one and the same common measure. Yet the advocates of 'indivisible' lines maintain *both* (i) that any line can become 'commen-

Hence their procedure is ridiculous, since, whilst professing 12 that they are going to demonstrate their thesis in accordance with the opinions of the mathematicians, and by premisses drawn from the mathematicians' own statements, they lapse into an argument which is a mere piece of contentious and sophistical dialectic—and such a feeble piece of sophistry too! For it *is* feeble in many respects, and totally ⟨unable⟩ to escape paradox on the one side, and destructive scientific criticism on the other.[1]

Moreover, it would be absurd for people to be led astray by 16 Zeno's argument, and to be persuaded—because they cannot refute it—to invent indivisible lines: and yet to pay no attention to all those theorems concerning lines, in which it is proved that it is impossible for a movement to be generated such that in it the moving thing does *not* fall successively on each of the intervening points before reaching the end-point. For the 25 theorems in question are far better established, and more generally admitted, than the arguments of Zeno.[2]

surate', *and* (ii) that all commensurate lines have a common measure: and these two propositions are inconsistent. For (i) is true only if 'commensurate' be used in a *relative* sense; and then (ii) is false. Whilst (ii) is true only if 'commensurate' be used in an absolute sense; and then (i) is false.

[1] [b]12–16. Bekker reads *ὥστε γελοῖον τὸ* [*τὸ* om. W[a]] *κατὰ* [*καὶ* N] *τὰς ἐκείνων δόξας καὶ ἐξ ὧν αὐτοὶ λέγουσι φάσκοντες δείξειν, εἰς ἐριστικὸν ἅμα καὶ σοφιστικὸν ἐκκλίνειν* [*ἐγκλίνειν* LPW[a] *ἐγκλίναι* N] *λόγον, καὶ ταῦθ' οὕτως ἀσθενῆ. πολλαχῇ* [*πολλαχῶς* LPW[a]] *γὰρ ἀσθενής ἐστι καὶ πάντα τρόπον διαφυγεῖν καὶ τὰ παράδοξα καὶ τοὺς ἐλέγχους.*

By reading *φάσκοντας* in l. 13 very tolerable sense may be made of the first sentence. Apelt follows N and reads *τὸ καὶ τὰς κτλ . . . ἐγκλίναι . . .* 'ridiculum est et illorum (sc. mathematicorum) placita et ea, quibus ipsi argumenta sua superstruunt, in sophisticas captiones detorquere.' But *αὐτοί* (cf. 968[b] 4, to which this refers) is most naturally taken as 'the mathematicians': and in any case Apelt's interpretation is not convincing.

The last sentence seems to be corrupt. The general sense of the passage would be satisfied by *πάντα τρόπον ἀδύνατος* (or *ἀδυνατεῖ) διαφυγεῖν* . . .: but I hesitate to propose any reading. The point seems to be that the advocates of indivisible lines are exposed to a double fire. They are using as an argument what to common sense is ridiculous paradox, and what to professional mathematicians is demonstrably unscientific.

[2] [b]16–26. In the above paraphrase I think I have reproduced the general drift of this passage. Zeno showed that if a body is to move from A to B, it must touch all the intermediate points before reaching B: i.e. it must traverse an infinity in a finite time. And he argued that motion is impossible. The advocates of indivisible lines replied: 'Motion is a

26 § 3. It is clear, then, that the being of indivisible lines is neither demonstrated nor rendered plausible—at any rate by the arguments which we have quoted. And this conclusion will grow clearer in the light of the following considerations :—

29 (A) In the first place,[1] our result will be confirmed by reflection on the conclusions proved in mathematics, and on the assumptions[2] there laid down—conclusions and assumptions

fact, and therefore—since Zeno's argument is sound—the line *AB* must consist of a finite number of indivisible unit-lines.' The writer here rejoins : 'Geometry proves that there can be no motion without the phenomenon to which Zeno called attention. A motion, such as your theory requires—a motion in which the moving body does not traverse successively all the intermediate points—does not, and cannot, occur. And the theorems, in which geometry establishes this, are far more convincing than the arguments of Zeno.'

In other words :—Geometry, assuming motion to be a fact, shows that the moving thing *does* traverse an infinity of intervening points, and shows that there can be no motion in which this does not take place. The advocates of indivisible lines have made no attempt to refute these geometrical proofs. Their postulate of 'indivisible lines', even if it evaded Zeno, collides with these far more solid facts of geometry : for the kind of motion which would occur, if there were indivisible lines, is shown by geometry to be impossible.

The text of this passage is so corrupt that it seems hopeless to make out the details of the argument.

In ll. 19–21 the writer is clearly referring to the movement of a straight line about one of its terminal points, whereby a semicircle (and, ultimately, a circle) is generated. *διάστημα* is the regular term in Euclid for the distance at which, from a given point as centre, the circumference of a circle is drawn. Cf. e.g. Eucl. *Elem.* I. 22 . . . *κέντρῳ μὲν τῷ* Z, *διαστήματι δὲ τῷ* ZΔ *κύκλος γεγράφθω ὁ* ΔKΛ . . ., and so constantly. (*διάστημα* in fact = 'radius'.)

In l. 19 we should read with Apelt *διὰ δὲ ⟨τὴν⟩ τῆς εὐθείας εἰς τὸ ἡμικύκλιον* [so NZa : the other MSS. read *ἡμιόλιον*] *κίνησιν*, . . .

But Apelt (in the *Prolegg.* to his text) proposes other emendations for the rest of the passage, which are not convincing. It is best to recognize that the passage is hopeless, until somebody can discover the exact geometrical theorems to which the writer is referring.

[1] b28 ff. The writer is going to show that the doctrine of indivisible lines cannot be reconciled with mathematics. It collides with the conclusions established in mathematics, and it collides with the premisses laid down by the mathematicians. He adduces a series of instances of such collision, and sums up at 970a 17 *ἄλλα δ' ἄν τις καὶ ἕτερα τοιαῦτα συνάγοι· πᾶσι γὰρ ὡς εἰπεῖν ἐναντιοῦται τοῖς ἐν τοῖς μαθήμασιν.*

πρῶτον μέν (b29) is answered by *πάλιν* (970a 19).

[2] b30. I have translated *τιθεμένων* 'assumptions'. It probably includes (*a*) definitions of the meaning of 'Subjects' and 'Attributes' (= Aristotle's *ὁρισμός*, where that is used in a restricted sense and contrasted with *ὑπόθεσις* : cf. e.g *Post. Anal.* 72a 21–24), and (*b*) Aristotle's *ἴδιαι ἀρχαί*, i.e. definitions of the meaning of the 'Subjects' accompanied by the *ὑπόθεσις ὅτι ἔστι* (cf. e.g. *Post. Anal.* 76a 32–36).

which we have no right to reject except on more convincing arguments than those adduced by the advocates of indivisible lines.[1]

For (i) neither the definition of ' line ', nor that of ' straight line ', will apply to the indivisible line, since the latter is not between any terminal points, and does not possess a middle.[2]

(ii) Secondly, all lines will be commensurate. For all lines 970a —both those which are commensurate in length, and those which produce commensurate squares—will be measured by the indivisible lines.

And the indivisible lines are all of them commensurate in length (for they are all equal to one another), and therefore also they all produce commensurate squares. But if so, then the square on any line will always be rational.[3]

[1] b30, 31. I read with Apelt (after NZa) *ἃ δίκαιον ἢ μένειν ἢ πιστοτέροις λόγοις κινεῖν.*

Since obviously the mathematician adduces no arguments in support of his *τιθέμενα*, I have interpreted *πιστοτέροις* as above. (It is possible, however, that we should translate ' more convincing than the mathematical statements ': cf. *de Caelo* 299a 5 *καίτοι δίκαιον ἦν ἢ μὴ κινεῖν ἢ πιστοτέροις αὐτὰ λόγοις κινεῖν τῶν ὑποθέσεων.*) The writer lays down the general principle that we are bound to accept the assumptions and conclusions of the mathematician in the sphere of mathematics, unless very convincing arguments are brought against them.

[2] b31–33. The first instance adduced by the writer to show that the theory of indivisible lines collides with *τὰ ἐν τοῖς μαθήμασι τιθέμενα.*

We must suppose that it was customary in contemporary mathematics to define *line* as ' that which is between two points ', and *straight line* as ' that, the middle point of which is in the way of [blocks] both ends '. For *the first definition*, cf. perhaps Arist. *Phys.* 231b 9, *στιγμῶν δ' ἀεὶ τὸ μεταξὺ γραμμή.* For *the second definition*, cf. perhaps Plato, *Parmen.* 137 E, where that *σχῆμα* is said to be *εὐθύ* " *οὗ ἂν τὸ μέσον ἀμφοῖν τοῖν ἐσχάτοιν ἐπίπροσθεν ᾖ* ".

[3] At 970a 4 I accept Apelt's conjecture, *ἀεὶ ῥητὸν ἔσται τὸ τετράγωνον* for the MSS. *διαιρετὸν ἔσται τὸ τετράγωνον.*

This second instance (969b 33–970a 4), in which the doctrine collides with mathematics, is a case partly of collision with the definitions of certain mathematical properties, partly of collision with certain demonstrated conclusions.

The writer complains that the doctrine of indivisible lines plays havoc (i) with the mathematical definition of ' commensurate ' lines, and the mathematical distinctions which follow from it ; for since all lines whatever consist of a whole number of these unit-lines, it follows that all lines are commensurate *μήκει*, and the mathematical distinction between surds and rational roots vanishes (969b 33–970a 2) : and (ii) with the mathematical definition of ' rational ' squares, and the distinction between ' rational ' and ' irrational ' squares which follows from it. For the indivisible lines

4 (iii) Again, since, in a rectangle, the line applied at right angles to the longer side determines the breadth of the figure: the rectangle, which is equal in area to the square on the indivisible line (v.g. on the line one foot long), will, if applied to a line double the indivisible line (v.g. to a line two feet long), have a breadth determined by a line shorter than the indivisible line: for its breadth will be less than the breadth of the square on the indivisible line.[1]

are all, *quâ* infinitesimal, equal: hence all commensurate μήκει, and therefore also commensurate δυνάμει (970a 2–4).

The point of the criticism is that the doctrine annihilates the mathematical conceptions of Commensurate and Incommensurate, Rational and Irrational.

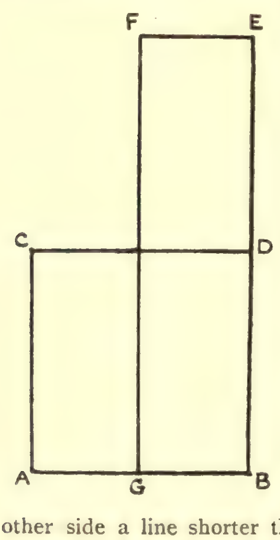
The passage should be compared with Euclid, *Elem.* X, deff. 2, 3 and 4 (see above, note on 968b14): and with Plato, *Theaet.* 147 D–148 B. In the *Theaetetus*, Theaetetus and Socrates the Younger are represented as having generalized certain results of the mathematician Theodorus (their master), and having divided all numbers into two series, thus:—

Series 1: Those numbers which, if regarded as the areas of rectangular figures, are squares with whole numbers as their sides, e.g. 4, 9, 16, 25, &c.

The roots of these square numbers are what we should call 'rational': or the sides of the squares are lines σύμμετροι μήκει, viz. containing whole numbers of the unit of length (the line one foot long).

Theaetetus and Socrates called the sides containing the squares in this series 'μήκη'.

Series 2: Those numbers which, if regarded as the areas of rectangular figures with whole numbers as their sides, are oblongs; or, if regarded as squares, have not whole numbers as their sides. To this series belong e.g. 3, 5, 6, 7, 8, &c.: and the sides containing these squares—e.g. $\sqrt{3}$, $\sqrt{5}$, $\sqrt{6}$, &c.—were called by Theaetetus and his friend 'δυνάμεις', i.e. δυνάμει σύμμετροι. (Cf. *Theaet.* 147 D ἥ τε τρίπους καὶ ἡ πεντέπους δυνάμεις are not μήκει σύμμετροι τῇ ποδιαίᾳ. *Ib.*, 148 B ὡς μήκει μὲν οὐ συμμέτρους ἐκείναις, τοῖς δ' ἐπιπέδοις ἃ δύνανται.)



We should call the 'sides' of this series of squares 'irrational square roots' or 'surds'.

[1] a4–8. In this passage I adopt Apelt's reading and interpretation throughout: *v.* Apelt, *Aristotelis quae feruntur*, &c., *prolegg.* pp. xiv, xv.

If we suppose the 'indivisible line' to be one foot long (cf. Arist. *Met.* 1052b 33—ἐν ταῖς γραμμαῖς χρῶνται ὡς ἀτόμῳ τῇ ποδιαίᾳ), then a rectangle, applied to a line two feet long, *must*—if its area is to be equal to the square on the indivisible line—have as its other side a line shorter than the indivisible line: which is absurd.

Let *AB* be the indivisible line, one foot long. Let *BE* be the line, two

(iv) Again, since any three given straight lines can be combined to form a triangle, a triangle can also be formed by combining three given indivisible lines. Such a triangle will be equilateral: but in every equilateral triangle the perpendicular dropped from the apex bisects the base. Hence, in the equilateral triangle whose sides are the indivisible lines, the 'indivisible' base will be bisected by the perpendicular dropped from its apex.[1] 8

(v) Again, if the square can be constructed of Simples (i.e. with indivisible lines as its sides), then let its diagonal be drawn, and a perpendicular dropped from one angle on to the diagonal. The square on the side (i.e. the original square constructed 11

feet long. Let *CABD* be the square on *AB*. If to the line *BE* there be applied a rectangular figure *GFEB* equal in area to *CABD*, *FE* or *GB* will be less than *AB*.

Though I accept Apelt's interpretation, there are one or two difficulties to which attention should be called. (1) *παραβάλλειν* is the technical term constantly used in Euclid (cf. e.g. *Elem.* I. 44, &c.) for 'applying' a rectangle or a parallelogram to a given line: i.e. for constructing such a figure with a given line as one of its sides. But (so far as I know) it is always the figure which '*παραβάλλεται*', not the side. Hence *παραβαλλομένη* here (970a 5) is suspicious.

(2) Euclid constantly uses the technical expression '*πλάτος ποιεῖ τὴν AB*' to mean '[a rectangle applied to such-and-such a given line] makes as its other side the line *AB*'. But, whatever may have been the original significance of the phrase, there is no implication in Euclid's usage that the side thus produced is *shorter* than the given line. So far as I have been able to discover, *πλάτος ποιεῖν* in Euclid (*a*) always has the accusative (e.g. '*τὴν AB*') expressing the line resulting, and (*b*) does not mean 'determines the breadth', but simply 'makes as its containing side (other than the given line)'. Cf. e.g. Euclid, *Elem.* X. 60, where the line thus produced is the longer of the two containing sides: and so often. But here (970a 5, a7) the writer speaks of a line 'making the breadth' (*τὸ πλάτος ποιεῖ*), and the expression must be distinguished from the technical phrase in Euclid.

(3) In 970a6 Apelt reads *τῷ ἀπὸ τῆς ἀτόμου καὶ τῆς ποδιαίας*. *τὸ ἀπὸ τῆς ἀτόμου* means 'the square on the indivisible line' (cf. above, note on 968b 14): and we are to take the *καί* as illustrative or explanatory. There is no serious difficulty here, though this introduction of the one-foot line is a little sudden. But the words in l. 8 are very difficult. Apelt there reads *ἔσται ⟨γὰρ⟩ ἔλαττον τοῦ ἀπὸ τῆς ἀτόμου*, and the words ought to mean 'For it'—presumably, 'the breadth'—'will be less than the square on the indivisible line'. As this is nonsense, and as the alternative rendering ('for it', viz. *the rectangle*, 'is less than the square') gives a meaning irrelevant to the argument, we have to translate 'For the breadth of the rectangle will be less than that of the square'. But I cannot say that the Greek justifies this translation.

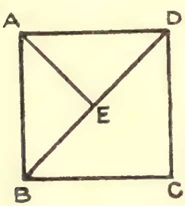
[1] a8–11. This argument presents no difficulty. Cf. Euclid, *Elem.* I. 10. *συνίστασθαι* is the regular term in Euclid for 'constructing' a figure.

with Simples as its sides) will be equal to the square on the perpendicular together with the square on half the diagonal. Hence the side of the square—i.e. the 'indivisible' line—will not be the smallest line.[1]

14 Nor will the area, which is the square on the diagonal, be double the square on the indivisible line. For ⟨suppose it to be so: then,⟩ if from the diagonal a length equal to the side of the original square be subtracted, the remaining portion of the diagonal will be less than the 'simple' line. For if the remaining portion of the diagonal were ⟨not less than, but⟩ equal to the 'simple' line, the square on the diagonal would have been four times the original square.[2]

[1] a11–14. I adopt Apelt's emendation διαμέτρου in l. 12 for the MSS. διὰ μέσου, and in l. 11 I read εἰ τὸ τετράγωνον ⟨ἐκ⟩ τῶν ἀμερῶν (sc. συνίσταται). The Latin translation by Rota has 'si quadratum ex quatuor insecabilibus lineis consistat', and LPW[a] omit τετράγωνον in a lacuna. Perhaps we should read εἰ τὸ τετράγωνον ἐκ τεττάρων ἀμερῶν, or εἰ ἐκ τεττάρων ἀμερῶν τετράγωνον.

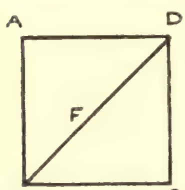
Another interpretation would be possible, if we retain the MSS. reading εἰ τὸ τετράγωνον τῶν ἀμερῶν, but alter ἐλαχίστη in l. 14 to ἐλάχιστον. 'If the square belongs to the class of Simples, then . . . [as above] . . . half the diagonal. Hence the "simple" square will not be the smallest square.' The argument would then be directed against the application of the theory of 'simples' to squares (cf. above, 968b14–16). The assumption of a least 'indivisible' or 'simple' square collides with Euclid, *Elem.* I. 47. For, let $ABCD$ be the 'simple', or 'minimal', square. Draw the diagonal BD, and the perpendicular AE bisecting BD at E. Then, since AEB is a right angle, $AB^2 = AE^2 + BE^2$, and therefore AE^2 and BE^2 are, each of them, smaller squares than the supposed smallest square, $ABCD$.



But the expression in l. 12 (ἡ τοῦ τετραγώνου πλευρά . . .), and also the argument in ll. 14–17, seem decisive in favour of the interpretation which I have adopted in the text.

[2] a14–17. In l. 17 I read (with N and Apelt) εἰ γὰρ ἴση, τετραπλάσιον ἂν ἔγραψεν ἡ διάμετρος. And after διάμετρος I read a full stop.

Geometers have proved (i) that the square on the diagonal = twice the square within which the diagonal is taken: i.e. that $BD^2 = 2ABCD$: and (ii) that if any line xy = twice any other line mn, $xy^2 = 4mn^2$.



Hence, it follows that BD in the square $ABCD$ is less than $2\,AB$: i.e. that, if from BD a portion $DF = AB$ be subtracted, the remainder BF is less than AB. If, therefore, AB is an 'indivisible' line, *either* BD^2 will not be equal to $2\,AB^2$ (but = at least $4AB^2$), *or* BD will contain FD $(= AB)$ + BF (a line less than the 'indivisible' line): the first alternative conflicts with an established geometrical conclusion, and the second alternative is absurd.

And one might collect other similar absurdities to which the doctrine leads; for indeed it conflicts with practically everything in mathematics.[1]

(B) Then again ⟨the following arguments support our criticism of the doctrine⟩:—[2]

(i) The Simple admits of only one mode of conjunction, but 19
a line admits of two: for one line may be conjoined to another either by contact along the whole length of both lines, or by contact at either of its opposite terminal points.[3]

(ii) Further, the addition of a line will not (on the theory) make the whole line any longer than the original line to which the addition was made: for Simples will not, by being added together, produce an increased total magnitude.[4]

(iii) Further, every continuous quantum admits more divi- 23
sions than one, and therefore no continuous quantum can be formed out of two Simples. And since every line (other than the indivisible line) is admittedly continuous, there can be no indivisible line: ⟨for if there were, a continuous quantum—viz. the line formed by the conjunction of two indivisible lines—would be formed out of two Simples.⟩[5]

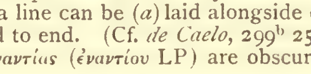
In l. 16 ἀφαιρεθέντος γὰρ τοῦ ἴσου, we should presumably understand μήκους.

[1] [a]17. The MSS. read ἄλλα δ' ἄν τις καὶ ἕτερα κτλ. Apelt conjectures ἄλογα δ' ἂν κτλ. There should, of course, be a full stop between διάμετρος and ἄλλα (or ἄλογα).

[2] [a]19. This begins a second series of arguments (in support of the writer's rejection of indivisible lines). πάλιν here corresponds to πρῶτον μὲν . . . (969[b] 29), which introduced the series of arguments just concluded.

[3] [a]19–21. What is 'simple' or 'without parts' can be conjoined with anything else only in one fashion. But a line can be (*a*) laid alongside of another line, or (*b*) conjoined with it, end to end. (Cf. *de Caelo*, 299[b] 25).

The words in [a]21 κατὰ τὸ πέρας ἐξ ἐναντίας (ἐναντίου LP) are obscure. I take them to mean 'at either of its contrary terminal points'. The *mode* of σύναψις is the same whether the line xy be conjoined with the line AB at A or at B, and at x or at y.



[4] [a]21–23. Apelt conjectures (from Pachymeres) ἔτι γραμμὴ ⟨γραμμῇ⟩ προστεθεῖσα . . .

The addition of γραμμῇ makes the Greek easier, but does not seem absolutely necessary.

[5] [a]23–26. I adopt Apelt's reading ἔτι ⟨εἰ⟩ ἐκ δυοῖν ἀμεροῖν μηδὲν γίνεται (γίνεσθαι MSS.), and also his punctuation, but not his interpretation.

I have paraphrased freely, so as to bring out the argument as I under-

26 (iv) Further, if every line (other than the indivisible line) can be divided both into equal and into unequal parts—every line, even if it consist of three or any odd number of indivisible lines—it will follow that the 'indivisible' line is divisible.[1]

stand it. The writer assumes (ἅπασα δὲ γραμμὴ παρὰ τὴν ἄτομον συνεχής) that even the advocates of indivisible lines admit that all *other* lines are continuous: and argues that a line compounded of two indivisible lines would, on their admission, have to be continuous, but could not be so on the principle that every *continuum* admits more than one division.

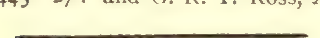
[1] a26–28. The MSS. read ἔτι εἰ ἅπασα γραμμὴ παρὰ [περὶ LNP, om. Z^a] τῆς ἀτόμου καὶ ἴσα [καὶ εἰς ἴσα L] καὶ ἄνισα διαιρεῖται καὶ μὴ ἐκ τριῶν ἀτόμων καὶ ὅλως περιττῶν ὥστ' ἀδιαίρετος ἡ ἄτομος.

I accept Apelt's reading (which is partly based on Hayduck's conjectures) ἔτι εἰ ἅπασα γραμμὴ παρὰ τὴν ἄτομον καὶ εἰς ἴσα καὶ ἄνισα διαιρεῖται, κἂν ᾖ ἐκ τριῶν καὶ ὅλως περιττῶν, ἔσται διαιρετὴ ἡ ἄτομος.

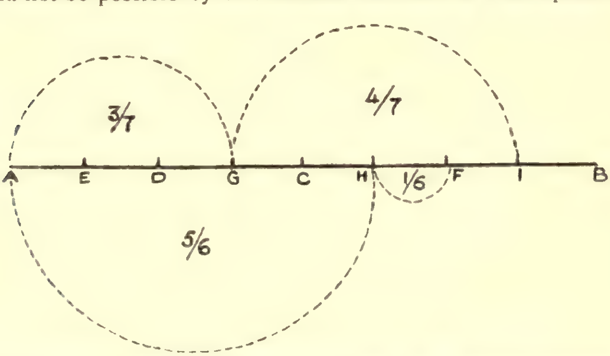
The writer is assuming, in the present series of arguments (970a 19–33), that the advocates of indivisible lines accept certain common mathematical assumptions as applying to the *composite* (non-indivisible) lines: and shows that their application is inconsistent with the 'indivisibility' of the unit-lines.

The assumption here stated is ἅπασα γραμμὴ καὶ εἰς ἴσα καὶ ἄνισα διαιρεῖται. This formula is constantly used by Euclid (cf. e.g. *Elem.* II. 5 and 9) to mean *bisection* and simultaneous division into *two* unequal parts. If we so understand it here, the argument is plain: but then l. 33 (ὅταν ἡ ἐκ τῶν ἀρτίων εἰς ἄνισα διαιρῆται) is unintelligible.

It seems best, therefore, to interpret 'into *any number* of equal, and *any number* of unequal parts'. And there is reason for thinking that 'division into unequal parts', as here contemplated, involved a process of progressive bisection. (Cf. e.g. Alexander's Commentary on Arist. *De Sensu*, 445b 27: and G. R. T. Ross, *Aristotle: De Sensu and De Memoria*, pp. 199–200.) If, e.g., the line AB was to be divided into $\frac{1}{4}$ and $\frac{3}{4}$, the method would be to bisect AB at C,



and again to bisect AC at D. AD would then be $\frac{1}{4}$, and DB $\frac{3}{4}$, of AB. It would not be possible by this method to divide AB into parts repre-

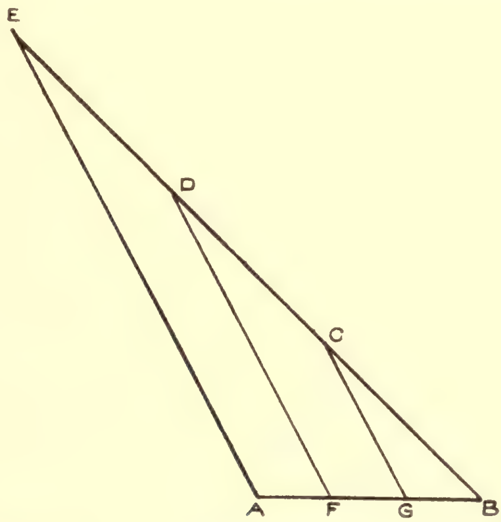


sented by fractions whose denominators were other than powers of 2: but it would be possible to exhibit such fractions *on* the line AB. Thus, e.g..

And the same will result if every line admits of bisection: for then every line consisting of an odd number of indivisible lines will admit of bisection, and this will involve the division of the 'indivisible' line.[1] 29

it would not be possible to divide *AB* into $\frac{3}{7}$ and $\frac{4}{7}$, nor into $\frac{5}{6}$ and $\frac{1}{6}$. But by triply bisecting *AB*, and eliminating $\frac{1}{8}$th, the remainder *AI* could be divided into $AG = \frac{3}{7}$ and $GI = \frac{4}{7}$: whilst, by eliminating $\frac{2}{8}$th, the remainder *AF* could be divided into $AH = \frac{5}{6}$ and $HF = \frac{1}{6}$.

There is no evidence in this passage that the writer knew of the following method for dividing any given line into any number of parts:—Let it be required to divide *AB* into (e.g.) three equal parts. From *B* draw *BC*



$= AB$, produce *BC* to *D*, making $CD = AB$: and produce *BD* to *E*, making $DE = AB$. Join *EA*; and from *D* and *C* draw *DF* and *CG*, each parallel to *EA*, to the points *F* and *G* on *AB*. *AF*, *FG*, and *GB* will then be, each of them, $\frac{1}{3}$rd of *AB*.

If we assume that the writer was unaware of this latter method, it is obvious (*a*) that no line consisting of an odd number of unit-lines could be 'divided into unequal parts', for the first bisection would divide the middle unit-line: and (*b*) that there would be a limit to the 'division into unequal parts' of lines consisting of an even number of unit-lines, since no such line could be progressively bisected *ad libitum* without dividing the unit-line (cf. 970a 33).

[1] a29, 30. Mathematicians further assume that every line can be bisected. If the advocates of 'indivisible' lines accept this assumption, it will apply to lines compounded of an odd number of unit-lines (πᾶσα γὰρ ἡ ἐκ τῶν περιττῶν, sc. δίχα τέμνεται): but they cannot be bisected unless the *middle* 'indivisible' line is divided.

And if not *every* line, but only lines consisting of an even number of units admit of bisection: still, even so, the 'indivisible' line will be divided, when the line consisting of an even number of units is divided into unequal parts (by progressive bisection).[1]

33 (C) Again,[2] ⟨the following arguments must be considered against the doctrine⟩:—

970b (i) If a body has been set in motion and takes a certain time to traverse a certain stretch, and half that time to traverse half that stretch, it will traverse less than half the stretch in less than half the time.[3] Hence if[4] the stretch be a length consisting of an odd number of indivisible unit-lines, we shall here again find[5] the bisection of the 'indivisible' lines, since the body will traverse half the stretch in the half time: for the time and the line will be correspondingly divided.[6]

So that none of the composite lines will admit of division both into equal and into unequal parts, nor will they admit of

[1] a30–33. In the above interpretation I have omitted altogether the words τὴν δὲ δίχα διαιρουμένην καὶ ὅσα δυνατὸν τέμνειν. These words as they stand will not translate. If we read καὶ εἰς ἄνισα in place of καὶ ὅσα, the meaning is plain enough: but the words are then not required for the argument.

Hayduck, and after him Apelt, conjectures καὶ ὁσαοῦν 'and if it is possible to divide (i. e. to bisect) the line which is being bisected (viz. the line with an even number of units) as many times as you please'. But, if my interpretation of διαίρεσις εἰς ἄνισα is right, these words are not required. Whilst, if my interpretation is wrong, I do not see how a valid argument is to be extracted from the passage. Apelt (cf. his *Prolegg.* p. xviii, note, p. xix: and his German translation of the passage) interprets ἄνισα as equivalent to περιττά, for which I can discover no justification.

[2] a33. πάλιν εἰ κτλ. This πάλιν answers to πάλιν τοῦ μὲν ἀμεροῦς (970a 19), and marks the beginning of a new group of arguments.

[3] The protasis extends to κινηθήσεται, and the apodosis is καὶ ἐν τῷ ἐλάττονι . . . ἡμίσειαν. We should therefore place a comma after κινηθήσεται (970b 2).

[4] b3. I adopt Apelt's conjecture εἰ μὲν ⟨ἐκ⟩ περιττῶν.

[5] b3. The MSS. read ἀναιρεθήσεται (Za fort. ἀνερεθήσεται). Apelt conjectures αὖ εὑρεθήσεται, but the position of the αὖ is impossible. I read ἀνευρεθήσεται ('redibit', Rota).

[6] b5, 6. Since the time is bisected, the stretch—i. e. the line, supposed in this case to consist of an odd number of units—will be bisected too.

After these words there is, I think, a lacuna. For nothing is said as to the case in which the stretch consists of an even number of units:—i.e. there is no clause to answer to εἰ μὲν ἐκ περιττῶν in 970b 3. And no use is made of the thesis established in 970b 2 (καὶ ἐν τῷ ἐλάττονι . . . τὴν ἡμίσειαν), which was probably intended to be applied in proving the divisibility of the unit-line, even when the stretch consisted of an even number of units.

division corresponding to the division of the times, if there are to be 'indivisible' lines.[1] And yet (as we said) the truth is, that the same argument, which leads to the view that lines consist of Simples, leads by logical necessity to the view that all these things (composite times, e.g., as well as composite lines) consist of Simples.[2]

(ii) Further, every line which is not infinite has two terminal 10
points: for line is defined by these. Now, the 'indivisible' line is not infinite, and will therefore have a terminal point. Hence it is divisible: for the terminal point and that which it terminates are different from one another. Otherwise there will be a third kind of line, which is neither finite nor infinite.[3]

(iii) Further, there will not be a point contained in every 14
line. For there will be no point contained in the indivisible line; since, if it contains one point only, a line will be a point, whilst if it contains more than one point it will be divisible. And if[4] there is no point in the indivisible line, neither will there be a point in any line at all: for all the other lines are made up out of the indivisible lines.[5] 18

[1] b7, 8. I read with Hayduck *οὐδ' ὁμοίως τοῖς χρόνοις τμηθήσονται, εἰ* [MSS. *οὐκ*] *ἔσονται* . . . The whole sentence is intelligible only if we assume that something has dropped out between *τμηθήσεται* and *ὥστε* in l. 6: see the preceding note.

[2] b8. *τὰ δὲ τοῦ αὐτοῦ λόγου ἐστί, καθάπερ ἐλέχθη, τὸ πάντα ταῦτα ποιεῖν ἐξ ἀμερῶν.*

The reference is to 969a 29, 30. For *τὰ δέ* we should presumably read *τὸ δέ*. By *πάντα ταῦτα* we must understand *primarily* *μήκη* and *χρόνοι*: but no doubt the statement is intended to apply to *all* composite quanta.

[3] b10–14. In b12 I read (with Bekker) *ἄλλο* for the MSS. *ἄλλου*. Every line, unless it be infinite, has two ends or limits, viz. its terminal points. The indivisible line, therefore, since it is not infinite, has two limits. But, if it has even *one* limit, it is divisible, viz. into (*a*) the limit, and (*b*) the limited. The only escape from this dilemma ('*either* infinite *or* limited and so divisible') would be to say that the 'indivisible lines' constitute a third class of line, neither finite nor infinite.

[4] b17. *εἰ μὲν οὖν* . . . What is the exact force of '*μὲν οὖν*' here? Does it mean 'And, what is more, if'? Or 'And if it be conceded that'?

[5] b14–18. In ll. 15–16 I read (with Apelt) *εἰ μὲν γὰρ μία μόνη ἐνυπάρξει, γραμμὴ ἔσται στιγμή* for the MSS. *εἰ μὲν γὰρ μία* [*μάλιστα* LPZa] *μόνη ὑπάρξει γραμμή, εἶτα στιγμή.*

The writer sets out to show that the geometrical principle, that 'in every line there is contained a point', will not hold of the 'indivisible' line. For if it contains but one point, it will be that point, i. e. a line will be a point: whilst if it contains more than one, it will be divisible. He then shows that it follows that this geometrical principle does not hold of *any* line, since all lines are (on the theory) either indivisible lines or com-

Moreover, if there are points in the indivisible line, there will either be nothing between the points, or a line. But if there is a line between them, and if all lines contain more points than one, the unit-line will not be indivisible.[1]

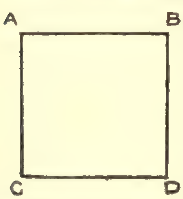
21 (iv) Again, it will not be possible to construct a square on every line. For a square will always possess length and breadth, and will therefore be divisible, since each of its dimensions—its length and its breadth—is a determinate something. But if the square is divisible, then so will be the line on which it is constructed.[2]

23 (v) Again, the limit of the line will be a line and not a point.[3] For it is the ultimate thing which is a limit, and it is the 'indivisible line' which is ultimate.[4] For if the ultimate thing be 'point', then the limit to the indivisible line will be a point, and one line will be longer than another by a point.[5] But if it be urged that the limiting point is contained *within* the

posites of these. For the geometrical principle cf. Arist. *Post. Anal.* 73[a] 31 καὶ εἰ ἐν πάσῃ γραμμῇ στιγμή . . .

[1] [b]18–20. I interpret this as a further argument to prove that there cannot be two (or more) points in the indivisible line. For suppose there are two points in it. Then *either* there is nothing between them, and then they collapse into an indistinguishable unity: *or* there is a line separating them. But then *this* line will itself contain two or more points, between which there must be another line, and so on *in infinitum*: hence the original unit-line will not be 'indivisible' if it contains two (or more) points.

[2] [b]21–23. This argument is very obscure, and perhaps the text is wrong. It is a principle of geometry that a square can be constructed on any given line: but it does not follow, because the length (*AB*) of the square *ABCD* is distinguishable from its breadth (*AC*), and because therefore the square is divisible into length and breadth, that *AB* or *AC* are themselves divisible *quâ* lines.



The Greek ἐπεὶ τὸ μέν, τὸ δέ τι seems suspicious, but I have no remedy to propose. Cf., however, the argument at 970[b] 30 ff. A square, if divided, must be divided 'at a line': i.e. its division must involve the division of its breadth or length. But this is impossible if its sides (and therefore all lines within it which are parallel to them) are 'indivisible' lines.

[3] In [b]24 I read with Apelt (after Hayduck) γραμμὴ ἔσται, ἀλλ' οὐ στιγμή for the MSS. στιγμὴ ἔσται [ἐστιν N], ἀλλ' οὐ γραμμή. N's ἐστιν is a transparent, but futile, attempt to make sense of the traditional reading.

[4] In [b]25 I accept Bussemaker's conjecture τὸ ἔσχατον, ⟨ἔσχατον⟩ δὲ ἡ ἄτομος.

[5] In [b]25 I retain the MSS. reading εἰ γὰρ στιγμή [sc. τὸ ἔσχατον], τὸ πέρας τῇ ἀτόμῳ ἔσται στιγμή. Apelt's conjecture, εἰ γὰρ στιγμὴ τὸ πέρας, ⟨πέρας⟩ τῇ ἀτόμῳ ἔσται στιγμή, though it would be convenient, is not necessary.

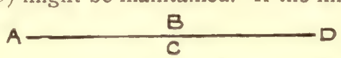
indivisible line, on the ground that two lines united so as to form a continuous line have one and the same limit at their juncture, then the simple line (i.e. the line without parts) will after all have a limit belonging to it.[1] 28

And, indeed, how will a point differ at all from a line on their theory? For the indivisible line will possess nothing characteristic to distinguish it from the point, except the name.[2]

(vi) Again, if there be indivisible lines, there must, by parity 30
of reasoning, be indivisible planes and solids too.[3] For the being of an indivisible unit in one dimension will carry with it the being of indivisibles in the remaining dimensions too,[4] since it is at a plane that a solid is divided, and at a line that a plane is divided. But there is no indivisible solid: for a solid contains depth and breadth. Hence neither can there be an 971a
indivisible line.[5] For a solid is divisible at a plane, and a plane is divisible at a line.[6]

[1] ᵇ23–28. τὸ ἔσχατον is the ultimate (or most elementary) thing in the spatial sphere: the not-further-reducible element of extended quanta. On the hypothesis of indivisible lines (the writer urges) this ultimate element of extension is the unit-line, and not the point. If it were the point, then *either* (*a*) the point limits the indivisible line *ab extra*, in which case the addition of a point would increase the length of a line: *or* (*b*) the point, which limits the indivisible line, is *internal* to it: but then the internal limiting point will be a distinguishable part of it, i.e. of that which is *ex hypothesi* without parts (cf. 970ᵇ 12, 13).

In ll. 27, 28 the words διὰ τὸ ταὐτὸ πέρας τῶν συνεχουσῶν γραμμῶν (sc. εἶναι) indicate the grounds on which (*b*) might be maintained. If the line *CD* be joined to the line *AB*, so as to make a continuous line *AD*, *B* and *C* become one and the same point, the end of *AB* and the beginning of *CD* (cf. Arist. *Phys.* 272ᵃ 10–13).



[2] ᵇ29, 30. ὅλως τε [read δὲ with N] τί διοίσει στιγμὴ γραμμῆς; The writer has just shown that the theory leads to the difficulty that a line must be terminated by a line and not by a point. From this special difficulty he now passes to the general difficulty that, on the theory, there can be no difference between 'point' and 'line', except in name.

[3] ᵇ31. The MSS. read ἔτι [ἔτι εἰ N] ὁμοίως μένει ἐπίπεδον καὶ σῶμά ἐστιν ἄτομον. For μένει Hayduck proposed μήκει, and Apelt μὲν καί. I accept Apelt's conjecture, and agree with Hayduck in reading ἔσται for ἐστιν. In ᵇ33 the MSS. read σῶμα οὐκ ἔσται [ἐστὶν NZᵃ] ἀδιαίρετον . . .: but we must follow the *editio princeps* and insert δὲ after σῶμα. This δέ will then correspond to the μέν in ᵇ31. I agree with Hayduck and Apelt in reading NZᵃ's ἐστὶν in ᵇ33 in place of ἔσται.

[4] ᵇ31, 32. Literally, 'For if one is indivisible, all the others will follow suit.'

[5] ᵃ1. I read with Apelt οὐδ' ⟨ἄρ'⟩ ἂν γραμμὴ εἴη . . .

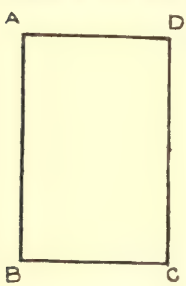
[6] ᵇ30–971ᵃ 3. If there are simple lines, there must be simple planes—viz.

3 But since the arguments by which they endeavour to convince us are weak and false, and since the opinions ⟨which they are trying to establish⟩ conflict with all the most convincing arguments, it is clear that there can be no indivisible line.[1]

§ 4. And it is further clear from the above considerations that a line can no more be composed of points than of indivisible lines. For the same arguments, or most of them, will apply equally against both views.

7 For (i) it will necessarily follow that the point is divided, when the line composed of an odd number of points is divided into equal parts, or when the line composed of an even number of points is divided into unequal parts.[2]

the planes bounded by those lines—and if there are simple planes there must be simple solids, viz. the solids contained by those planes. For to divide a solid is to divide it at a plane, and thus to divide all the planes at right angles to the plane of division. And to divide a plane (cf. above, 970^b 21–23) is to divide it at a line, and thus to divide all the lines at right angles to the line of division. Hence if every solid, however minute, is divisible, every plane must be divisible too: and if every plane, however small, is divisible, every line must be divisible too.



This appears to be the argument: but the reason given (971^a 1) for the divisibility of every solid is obscure, in the same way as the reason given for the divisibility of every square (970^b 23) was not convincing. And could not the advocates of 'indivisible lines' have insisted that a plane figure, though divisible, might yet have as *one* of its containing sides an 'indivisible line'? The oblong *ABCD*, e.g., might be divisible along its length *AB*, and yet indivisible in respect to its breadth *AD*: i.e. *AD* might be an 'indivisible line'.

[1] ^{a}3–5. This sums up the case against the indivisible lines. We have seen in § 2 that the arguments advanced in support of the theory are weak and false: and we have seen in § 3 that the tenets of the theory collide with the principles and conclusions of mathematics.

The text in these lines is not very satisfactory. We should expect a somewhat stronger particle than δέ in ^{a}3 to introduce a summing-up of this kind: but it is difficult to make a convincing emendation. The τε (οἵ τε λόγοι) is apparently answered by δέ in l. 4 (ἐναντίαι δὲ δόξαι), which is omitted by all the MSS. except N. Perhaps the grammatical structure is οἱ λόγοι . . . ἀσθενεῖς τε καὶ ψευδεῖς εἰσι? See Bonitz, Index, 749^b 44 ff.

All the MSS. in l. 4 read πᾶσαι except P, which has πᾶσι. Neither reading is entirely satisfactory. There seems no point in πᾶσαι, and πᾶσι is not strictly true—or at least has not been shown to be true.

τοῖς ἰσχύουσι [sc. λόγοις] πρὸς πίστιν—'the arguments strong to produce conviction' are presumably the mathematical arguments: cf. e.g. 969^b 30.

[2] ^{a}7–9. I adopt Hayduck's conjecture ᾗ ⟨ή⟩ ἐκ περιττῶν and ᾗ ⟨ή⟩ ἐξ ἀρτίων . . .

And (ii) it will follow that the part of a line is not a line, nor the part of a plane a plane.[1]

Further (iii) it will follow that one line is longer than another 10
by a point[2]: for it is by its constituent elements that one line will exceed another. But that it is impossible for one line to be longer than another by a point, is clear both from what is proved in mathematics and from the following argument. For, if it were possible, the absurd consequence would result that the moving body would take a time to traverse the point.[3] For, as it traverses the equal line in an equal time, it will traverse the longer line in a greater time: and that by which the greater time exceeds the equal time is itself a time.

Perhaps, however, we are to suppose that just as a line con- 16
sists of points, so also time consists of 'nows', and both theses belong to the same way of thinking. ⟨Let us then examine the doctrine that a line, or generally *continua*, like times and lengths, consist of discrete elements.⟩[4]

In l. 9 *τὰ ἄνισα* is strange: Z[a] omits *τά*.

The reference is to the obscure argument at 970ª 26–33.

[1] ª9, 10. If a line is made up of points, a plane on the same principle will be made up of lines: and the 'parts' of a line will be its 'points', and of a plane its 'lines'.

[2] ª10, 11. The MSS. read *καὶ γραμμὴ δὲ γραμμῆς στιγμῇ* [*στιγμὴ* W[a], *στιγμῆς* N] *εἶναι μείζων·*

I read, with Hayduck, *καὶ γραμμὴν δὲ γραμμῆς στιγμῇ εἶναι μείζω·*

[3] ª13. *τὴν στιγμήν*, i.e. *the* point, by which the longer line exceeds the shorter. I accept Hayduck's *διϊέναι* for the MSS. *δὴ εἶναι*.

[4] The writer is led off, by a possible rejoinder, to consider the view that time consists of 'nows'. But in the series of arguments which follows, the first argument alone directly mentions 'time' and 'nows': and though some of the subsequent arguments would apply to 'time' as well as to the line, many of them apply specially and only to lines. Hence I interpret 971ᵇ 3 and 4 as a *corollary*, and not as a summary: and I regard *the whole of* § 4 (971ª 6–972ª 13) as a connected series of arguments to show that a line cannot consist of points. The order of the writer's thought is, I think, as follows:—

(1) 971ª 6–16. Statement of the arguments which are fatal *both* to the doctrine that a line consists of indivisible lines, and to the doctrine that it consists of points: and statement of a new difficulty against the latter doctrine. This difficulty involves the conception of Time, and might be met by the rejoinder that Time, like Length, though continuous, consists of discretes. (2) 971ª 17–972ª 13. A group of arguments to show that a line cannot consist of points, the view that Time consists of Nows being incidentally refuted. This group of arguments is based on a disjunction, thus:—The points cannot be united to form the line *either* (*a*) by *συνέχεια* (971ª 17–20), *or* (*b*) by *σύνθεσις* (971ª 20–26), *or* (*c*) by *ἁφή* (971ª 26–ᵇ26), *or* (*d*) by *τὸ ἐφεξῆς* (971ᵇ 26–972ª 6).

17 (a) Since, then, the Now is a beginning and end of a [1] time, and the Point a beginning and end of a line; and since the beginning of anything is not 'continuous' with its end, but they have an interval between them; it follows that neither Nows nor Points can be continuous with one another.[2]

20 (b) Again, a line [3] is a magnitude: but the 'composition' of points constitutes no magnitude, because several points put together occupy no more space than one. For when one line is superimposed on another and coincides [4] with it, the breadth is in no wise increased. And since points too are contained in the line thus superimposed, it follows that neither would points, by being superimposed on points, occupy more space. Hence points would not constitute a magnitude by composition.[5]

Of these four alternatives *σύνθεσις* is used by Aristotle as the general term to express any kind of combination of a manifold: cf. e.g. *Top.* Z 13, 150ᵇ 22, Z 14, 151ᵃ 20–32. Here, however, as we shall see, the writer appears to use it to express one special kind of combination. The remaining alternatives are treated by Aristotle as exhausting the ways in which points might be supposed to cohere to form a line: cf. Arist. *Phys.* 231ᵃ 18 ff. Aristotle's definitions (*Phys.* l.c.), which the writer here assumes, are '*συνεχῆ μὲν ὧν τὰ ἔσχατα ἕν, ἁπτόμενα δ' ὧν ἅμα, ἐφεξῆς δ' ὧν μηδὲν μεταξὺ συγγενές*'.

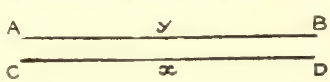
[1] ᵃ18. *τοῦ χρόνου*, i.e. any given period of time.

[2] ᵃ17–20. Two things are called 'continuous' when the end of one is identical with the beginning of the other. But the Nows and the Points are themselves Ends and Beginnings, or Extremes (*ἔσχατα*), and cannot therefore be 'continuous' with one another.

[3] ᵃ21. *ἡ μὲν γραμμή* 'the line', i.e. any and every line: cf. 971ᵃ 18, *τοῦ χρόνου.*

[4] ᵃ23. For this use of *ἐφαρμόζειν* cf. e.g. Euclid, *Elem.* I. 4, "*ἐφαρμόσει καὶ τὸ B σημεῖον ἐπὶ τὸ E . . .*"

[5] ᵃ20–26. In this argument the writer seems to be excluding a view that point is applied to point so as to 'compound' a line. Line is length without breadth: and if line be applied to line, the two coincide, fall on one another, and do not produce a surface, i.e. do not 'increase the breadth' of the first line. So point is position without magnitude, and no application (composition or addition) of point to point can produce magnitude—i.e. length. If the line *AB* be applied to the line *CD*, the points in *AB* will coincide with the points in *CD*: and as the line *CD* is no 'broader' than it was before, neither will any point *x* in *CD* become a length by 'composition' with the corresponding point *y* in *AB*. There is some difficulty in the text. In 971ᵃ 22 the MSS. read *διὰ τὸ μηδ' ἐπὶ πλείω τόπον ἔχειν.* Should we perhaps read *διὰ τὸ μηδ' ἔτι πλείω τόπον κατέχειν*? In l. 24 I retain the MSS. reading *ἐν δὲ τῇ γραμμῇ . . .* (Apelt's emendation *εἰ δὲ τῇ γραμμῇ . . .* does not suit the movement of the argument.) But I read



(c) Again, whenever one thing is 'contiguous' with another, the contact is either whole-with-whole, or part-with-part, or whole-with-part. But the point is without parts. Hence the contact of point with point must be a contact whole-with-whole.[1] 26

But if one thing is in contact with another whole-with-whole, the two things must be one. For if either of them is anything in any respect in which the other is not, they would not be in contact whole-with-whole.[2]

But if the Simples ⟨when in contact⟩ are ⟨not 'one', but⟩ 'coincident', then a plurality occupies the same place which was formerly occupied by one: for if two things are coincident and neither admits of being extended beyond the coincidence, just so far the place occupied by both is the same. And since 971b
the Simple has no dimension, it follows that a continuous magnitude cannot be composed of Simples. Hence neither can a line consist of Points nor a time of Nows.[3]

in l. 25 *οὐδ' ἂν ⟨ἄρ'⟩ αἱ στιγμαὶ . . .*, and alter the punctuation, so that the whole passage runs as follows:—

. . . μεῖζον τὸ πλάτος· ἐν δὲ τῇ γραμμῇ καὶ στιγμαὶ ἐνυπάρχουσιν· οὐδ' ἂν ⟨ἄρ'⟩ αἱ στιγμαὶ πλείω κατέχοιεν τόπον, ὥστε οὐκ ἂν ποιοῖεν μέγεθος.

[1] In a27, 28 I read with Apelt (after Hayduck) *ἡ δὲ στιγμὴ ἀμερής, ὅλως ⟨ἂν⟩ ἅπτοιτο.*

The principle that all contact must be whole-with-whole, or part-with-part, or whole-with-part, is enunciated by Aristotle (*Phys.* 231b 2), and applied similarly to *ἀδιαίρετα* and specially to points.

[2] a29. The MSS. read *εἰ γάρ τι* [*τις* NZa] *ἐστὶν ᾗ θάτερον μή ἐστιν . . .*: I read *ᾗ θάτερον* (cf. the Latin transl. 'si quid remanet quod alteri non coniungatur').

Apelt conjectures *εἰ γὰρ δὶς* (or *δύ'*) *ἐστὶν . . .* 'si totum bis est vel non simul alterum complectitur . . .'

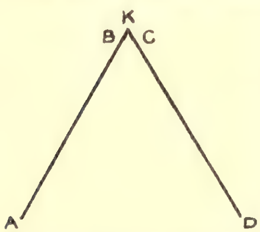
[3] a26–b4. The outline of the argument is as follows:—The contact of Points, *quâ* Simples, must be whole-with-whole. Now two things are 'contiguous' when their extremities are *ἅμα*, 'coincident' or 'together'. But since Simples have no parts—no extremities in distinction from the rest of themselves—the contact of Simples must mean absolute unity. If this be denied, and it be maintained that the 'contiguous' Simples are 'coincident', but remain 'two': it will follow that two or more Simples can be 'coincident' without taking up more place than one Simple, and therefore (since *one* Simple has no dimension, i.e. no inner extension) no continuous magnitude can be composed of Simples. And a corollary of this is, that a line cannot consist of points, nor a time of 'nows'.

In 971b 1 I read, with LPWaZa, *ἐπέκτασιν, κατὰ ταῦτα ὁ αὐτὸς κτλ.* Apelt's conjecture (*ἐπέκτασιν καθ' ἑαυτά, ὁ αὐτὸς . . .*) is tempting, but unnecessary.

In 971b 2 *διάστασις* = dimension, cf. Bonitz, Index, 189a 30 ff.

4 (d) Further, if the line consists of points, point will be in contact with point. If, then, from *K* there be drawn the lines *AB* and *CD*, the point *B* in the line *A*(*B*)*K* and the point *C* in the line *K*(*C*)*D* will both be in contact with *K*.[1] So that the points *B* and *C* will also be in contact with one another: for the Simple, when in contact with the Simple, is in contact whole-with-whole. So that the points will occupy the same place as *K*, and, *quâ* in contact with *K*, will be in the same place with one another. But if they are in the same place with one another, they must also be in contact with one another: for things which are in the same 'continent' place must be in contact.[2] But, if this is so, one straight line will touch another

[1] b4-6. The writer assumes *for the present* that, if a line is made up of points, the points within the line are in contact with one another. Having laid down this assumption, he then proceeds (*ἐὰν οὖν*—: *οὖν* is omitted by LP, but is required) to suppose that from the point *K* two lines, each consisting of points, are drawn. He calls these lines '*AB*' and '*CD*'; but it is clear, from what follows, that the points *B* and *C* are the terminal points of the lines contiguous to *K*, i.e. that *A* and *D* are the end-points furthest removed from *K*.



[2] b7-11. This is directed to prove that, since *B* and *C* are in contact with *K*, they are also in contact with one another. The text is corrupt, and I have ventured to read and punctuate as follows:—

ὥστε καὶ ἀλλήλοιν [so Apelt for the MSS. *ἄλλων, ἄλλῳ, ἄλλῳ τινί.* Hayduck conjectured *ἀλλήλων*]. *τὸ γὰρ ἀμερὲς τοῦ ἀμεροῦς ὅλον ὅλου ἐφάπτεται· ὥστε τὸν αὐτὸν ἐφέξει τόπον τῷ* K, *καὶ τοῦ* K *ἁπτόμεναι αἱ στιγμαὶ ἐν τῷ αὐτῷ τόπῳ ἀλλήλαις. εἰ δ' ἐν τῷ αὐτῷ, καὶ ἅπτονται· τὰ γὰρ ἐν τῷ αὐτῷ τόπῳ ὄντα πρώτῳ* [so Hayduck for the MSS. *πρῶτα* or *πρῶτον*] *ἅπτεσθαι ἀναγκαῖον.*

For the meaning of *πρώτῳ*, cf. e.g. *Phys.* 209a 32 ff., *καὶ τόπος ὁ μὲν κοινός, ἐν ᾧ ἅπαντα τὰ σώματά ἐστιν, ὁ δ' ἴδιος ἐν ᾧ πρώτῳ. . . .* The 'proper' or 'primary' place of a thing is further explained as that which contains precisely the thing and nothing more, i.e. the continent boundary of the thing. Cf. also *Phys.* 226b 21-23.

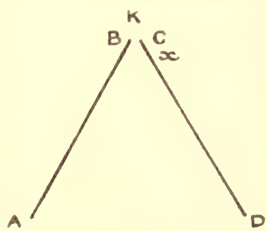
The argument moves thus: '*B* and *C* are in contact with *K*. But *B* and *C* are points, i.e. Simples. And contact of Simples is contact whole-with-whole, i.e. complete coincidence. Hence the "continent place" of *B* is identical with that of *K*, and the "continent place" of *K* is identical with that of *C*. And therefore the "continent place" of *B* is identical with that of *C*. But this means that *B* is in contact with *C*.'

In 971b 8 the MSS. read . . . *ἐφέξει τόπον τοῦ* K, *καὶ ἁπτόμεναι στιγμαὶ* . . . Apelt conjectures *ἐφέξει τόπον* ⟨*τῷ* K· *ἔσονται οὖν καὶ αἱ*⟩ *τοῦ* K *ἁπτόμεναι στιγμαὶ κτλ.* This involves more change than the reading which I propose: and, after all, it is not satisfactory. For the writer shows that *B* and *C*, *quâ points in contact with a third point*, *K*—i.e. *quâ* straight line in two points. For the point (B) in the line AK touches both the point KC and another ⟨viz. the point contiguous to C in the line $K(C)D$⟩. Hence the line AK touches the line CD in more points than one.[1]

And the same argument would apply not only in the case supposed, where two lines were in contact with one another at the point K, but also if there had been any number of lines touching one another at K.[2]

in contact with K whole-with-whole—must have one and the same 'continent place' as K, and therefore as one another: and therefore must be in contact with one another. The nerve of the argument is contained in the words 'and *the points*, *because* in contact with K': but Apelt's reading could only be translated 'Therefore the points *which are* in contact with K will also be in the same place as one another'. (Apelt's note on l. 9 *εἰ δ' ἐν τῷ αὐτῷ* . . . 'scribendum potius videtur *γὰρ*', shows that he has failed to follow the writer's argument.)

[1] ^{b}11–14. The writer, having proved that the terminal points B and C are in contact at K, shows that the two straight lines BA and CD will be in contact at more than one point—v. g. at x, since C is in contact with x and B with C.

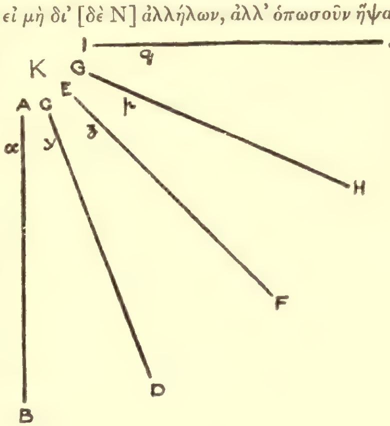


At l. 11 I adopt Hayduck's *εἰ δ' οὕτως* for the MSS. *εἶθ' οὕτως*, and I read a full stop before these words.

At ^{b}12, 13 I read *καὶ τῆς* ΚΓ (for the MSS. *καὶ τῇ* ΚΓ) *καὶ ἑτέρας* . . . Apelt follows Hayduck in reading *καὶ* ⟨*τῆς ἐν*⟩ *τῇ* ΚΓ. But 'ΚΓ' is the *στιγμὴ* ΚΓ, *not* the *γραμμή*. If the writer had meant *the line*, he would have written ΚΔ or ΓΔ as in l. 6 or in l. 13 (*τῆς* ΓΔ).

Finally, in l. 13 I read (with Hayduck and Apelt) *ὥστε ἡ* ΑΚ in place of the MSS. *ὥστε εἰ ἐκ* or *ἡ ἐκ*.

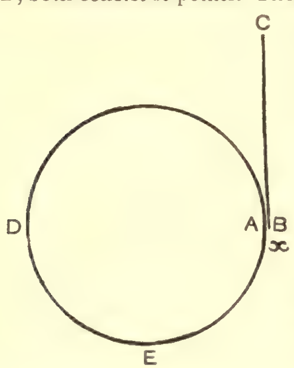
[2] ^{b}14, 15. The MSS. read *καὶ εἰ μὴ δι'* [*δὲ* N] *ἀλλήλων, ἀλλ' ὁπωσοῦν ἥψατο γραμμῆς* [*ὁποσοῦν ἥψατο γραμμὴ* Z^{a}]. I have adopted Apelt's conjecture *καὶ εἰ μὴ δύ' ἀλλήλων, ἀλλ' ὁποσαιοῦν ἥψαντο γραμμαί*. If this is right, we must suppose a number of lines, e.g. AB, CD, EF, GH, IJ, all drawn from K. The points A, C, E, G, I, *quâ* all in contact with K, are all in contact with one another: and also severally in contact with the points x, y, z, p, q. Hence the lines AB, CD, EF, GH, IJ will be in contact with one another at more points than one.



(e) Further, if a line consist of points in contact with one another, the circumference of a circle will touch the tangent at more points than one. For both the point on the circumference and the point in the tangent touch the point of junction and also touch one another.[1] But since this is not possible, neither is it possible for point to touch point. And if point cannot touch point, neither can the line consist of points: for if it did, they would necessarily be in contact.[2]

(f) Moreover, how—on the supposition that the line consists of points—will there any longer be straight *and* curved lines? For the conjunction of the points in the straight line will not differ in any way from their conjunction in the curved line. For the contact of Simple with Simple is contact whole-with-whole, and Simples admit no other mode of contact. Since, then, the straight and curved lines are different, but the conjunction of points is invariably the same, clearly a line will not be curved or straight because of the conjunction: hence neither will a line consist of points.[3]

[1] b15–18. Let the circumference of the circle DEA, and let the tangent CB, both consist of points. The point of juncture, x, will be in contact with



the point B of the tangent $CB(x)$, and also with the point A of the circumference $DEA(x)$: hence the point A will also be in contact with the point B. And the tangent $CB(x)$ will touch the circumference $DEA(x)$, at A, at x, and at B.

[2] b18–20. In l. 20 I read, with Hayduck, οὐδ' εἶναι τὴν γραμμὴν στιγμῶν [MSS. στιγμήν. Perhaps we ought to read ἐκ στιγμῶν]· οὕτω [MSS. and Apelt οὐδὲ] γὰρ ἅπτεσθαι ἀναγκαῖον.

Apelt defends οὐδέ 'si linea ex punctis constaret, necessario a contactu excluderetur (quod tamen fieri nequit)'. And, in his German translation, he interprets 'Denn sie (die Linie) wäre dann notwendig von der Berührung ausgeschlossen'. But the Greek cannot mean this: nor, if it could, would there be any valid argument in the words.

[3] b20–26. In l. 24 I read (with Apelt and Hayduck) ἄλλως ἅπτεσθαι for the MSS. ὅλως [ὅπως Wa] ἅπτεσθαι.

ll. 24–26 are difficult. I take the writer to mean: 'The theory might attempt to distinguish Straight from Curved, on the ground that point is attached to point differently in these different types of line. But points are Simples, and therefore point can be attached to point in one way only. Hence we cannot derive the different characters of the straight and curved

26 (g) Further, the points (of which the line consists) must either touch or not touch one another. Now if 'the next' in a series must touch the preceding term, the same arguments, which were advanced above, will apply: but if there can be 'a next' without its being in contact ⟨with its predecessor or successor⟩, yet by 'the continuous' we mean nothing but a composite whose constituents are in contact. So that the points forming the line must be in contact, in so far as the line must be continuous, even though we suppose the points to be a 'series'.[1]

(h) † ἔτι εἰ ἄτοπον στιγμὴ ἐπὶ στιγμῆς [ἐπιστήμη Zª], ἵν' ᾖ **972a** [ἢ PZª] γραμμὴ καὶ ἐπὶ στιγμῇ, [γραμμὴ καὶ ἐπιστήμης NWª, ἐπιστήμη καὶ γραμμή Zª], ἐπεὶ ἡ γραμμὴ ἐπίπεδον, ἀδύνατον τὰ εἰρημένα εἶναι.[2] † For if the points form a series without

lines from a difference in the mode of contact of their points. And so the theory that lines consist of points in contact breaks down: for it cannot account for the difference between straight and curved.'

In b25 one may suspect some corruption in the text. The MSS. read οὐκ ἔσται δὴ γραμμὴ ἐκ τῆς συνάψεως. The sense required is given in Rota's translation—'non fiet ex punctorum contactu linea circularis et recta.'

[1] b26–31. The writer has shown that the points, of which the line is supposed to consist, cannot be regarded as united (*a*) by συνέχεια, (*b*) by σύνθεσις, nor (*c*) by ἁφή. He now argues against (*d*) the view that they constitute 'a series', that they are united by τὸ ἐφεξῆς. (Cf. above, note on 971a 16.) He urges here that, whatever may be the case with some 'series', the *series of points* must be a series whose members are contiguous, since otherwise they would not form a *continuum*—i. e. they would not form a line. It appears from *Phys.* 227a 17–23 that all *continua* must have their parts 'in contact': and all things 'in contact' must be ἐφεξῆς. But there may be τὸ ἐφεξῆς without 'contact' (e.g. the numerical series), and there may be 'contact' without the contiguous plurality constituting a *continuum*.

In ll. 29–31 I read as follows:—τὸ δὲ συνεχὲς οὐδὲν ἄλλο λέγομεν ἢ τὸ ἐξ ὧν ἐστὶν ἁπτομένων· ὥστε καὶ οὕτως ἀνάγκη τὰς στιγμὰς ἅπτεσθαι, ᾗ [MSS. ἢ] εἶναι γραμμὴν συνεχῆ.

The clause τὸ δὲ συνεχὲς . . . ἁπτομένων is direct, and does not depend on εἰ in l. 28. The δὲ is resumptive. καὶ οὕτως, viz. even supposing that the points are ἐφεξῆς.

ᾗ εἶναι γραμμὴν συνεχῆ, viz. ᾗ ἀνάγκη ἐστὶν εἶναι κτλ.

The meaning concealed in the corrupt τὸ ἐξ ὧν ἐστὶν ἁπτομένων is rightly given by Rota, 'quod est ex se tangentibus compositum.'

[2] a1–3. The text is here hopelessly corrupt. Apelt conjectures ἔτι, εἰ ἄτοπον στιγμὴν ἐπὶ στιγμῆς εἶναι ᾗ γραμμὴν καὶ ἐπὶ στιγμῆς, ἐπὶ δὲ γραμμῆς ἐπίπεδον κτλ.: and (v. *prolegg.*, p. xxii) interprets 'si fieri nequit ut puncto iuxta positum punctum adiungatur, quatenus ne linea quidem puncto iuxta posita adiungi potest neque planum lineae . . .' But I do not see how he could defend this translation of his Greek: nor do I see how 972a 3–6 connect with this opening sentence. In his German translation

contact, the line will be divided not at either of the points, but between them: whilst if they are in contact, a line will be the place of the single point. And this is impossible.[1]

6 (j) Further, all things would be divided, i.e. be dissolved, into points; and the point would be a part of a solid, since the solid—on the theory—consists of planes, the plane of lines, and the lines of points. And since those constituents, of which (as their primary immanent factors) the various groups of things are composed, are 'elements', points would be 'elements' of bodies. Hence 'elements' would be identical in nature as well as in name, and not even specifically different.[2]

12 § 5. It is clear, then, from the above arguments that a line does not consist of points.[3]

(a) But neither is it possible to subtract a point from a line. For, if a point can be subtracted, it can also be added. But if anything is added, that to which it was added will be bigger than it was at first, if that which is added be such as to coalesce and form one whole with it.[4] Hence a line will be bigger than another line by a point.[5] And this is impossible.

But though it is not possible to subtract a point *as such* from a line, one may subtract it *incidentally*, viz. in so far as a point

he proposes to read ἂν ᾖ γραμμὴ καὶ ἐπὶ στιγμῇ, which he translates 'wenn auch eine Linie auf einem Punkte sein kann': but one may envy, without wishing to imitate, this free-and-easy attitude to Greek Grammar. It seemed best to own myself defeated, and simply to print the original Greek.

[1] ª3–6. For the argument, cf. above, 971ª 28 ff. But what bearing has this dilemma (εἴτε γὰρ . . . εἶθ' ἅπτονται) on the preceding lines?

[2] ª6–11. In l. 11 I read with Apelt, after the MS. Wª, οὐδ' ἕτερα, for Bekker's οὐδέτερα.

The common name 'στοιχεῖον' would indicate a genuine identity of nature in the different things called 'elements': indeed, *complete* identity of nature, and not merely generic identity with specific differences.

In l. 10 ἕκαστα means, of course, not each thing, but each group or kind of thing.

[3] The writer has shown that a line is not in any sense a *sum* of points. He now shows that you cannot speak of *subtracting* a point from a line: and from this proceeds to criticize other erroneous statements about 'points'.

[4] In ª15 the MSS. read τὸ προστεθὲν (τὸ προστεθήτω L) μεῖζον ἔσται τοῦ ἐξ ἀρχῆς.

Apelt conjectures τὸ ᾧ προσετέθη μεῖζον κτλ., and this seems undoubtedly right. The corruption may have arisen from the mistaken assumption that τοῦ ἐξ ἀρχῆς means 'than the original quantum'.

[5] In ª17 I read with Hayduck ἔστι ⟨ἄρα⟩ γραμμή κτλ.

is contained in the line which one is subtracting from another line. For since, if the whole be subtracted, its beginning and its end are subtracted too; and since the beginning and the end of a line are points: then, if it be possible to subtract a line from a line, it will be possible also thereby to subtract a point. But such a subtraction of a point is *incidental* or *per accidens*.[1]

(b) But if the limit *touches* that of which it is the limit (touches either *it* or some one of its parts), and if the point, *quâ* limit of the line, touches the line, then the line will be greater than another line by a point, and the point will consist of points. For there is nothing between two things in contact.[2]

The same argument applies in the case of division, since the 'division' is a point and, *quâ* dividing-point, is in contact with something. It applies also in the case of a solid and a plane. And the solid must consist of planes, the plane of lines, just as (on the theory) the line consists of points.[3]

[1] [a]20–24. I follow Hayduck and Apelt in reading *εἰ ⟨γὰρ⟩ τοῦ ὅλου ἀφαιρουμένου καὶ ἡ ἀρχὴ καὶ τὸ πέρας ἀφαιρεῖται, γραμμῆς δ' ἦν ἡ ἀρχὴ καὶ τὸ πέρας στιγμή, καὶ εἰ γραμμῆς ⟨γραμμὴν⟩ ἐγχωρεῖ ἀφαιρεῖν, καὶ στιγμὴν ⟨ἂν⟩ ἐνδέχοιτο.*

[2] [a]24–27. The writer shows that it is wrong to conceive the limit as 'in contact' with that which it limits, and the point as 'in contact' with the line or any part of it.

In l. 24 I read (with Apelt) *οὗ τὸ πέρας* for the MSS. *οὔτε πέρας.*

In l. 25 I punctuate . . . *ἐκείνου τινός, ἡ δὲ στιγμή, ᾗ πέρας, γραμμῆς ἅπτεται,* and in l. 26 I adopt Apelt's conjecture *ἡ μὲν οὖν ⟨γραμμὴ⟩ γραμμῆς ἔσται στιγμῇ μείζων* for the MSS. *ᾗ μὲν οὖν γραμμῆς ἔσται στιγμὴ μείζων* [N *ἡ μὲν οὖν γραμμὴ ἔσται στιγμῆς μείζων*].

If the point *C becomes* the limit of the line *AB*, and is therefore 'in contact' with *AB*, then (i) $BA + C$ is $> BA$ by the point *C*, and (ii) the terminal point *C* of the line *CAB* is the *composite* point $C + A$: for *C* and *A* are in contact whole-with-whole, and there is nothing between them.

[3] [a]28–30. This passage is obscure owing to its brevity. In l. 28 I read (with NW[a]) *ὁ ⟨δ'⟩ αὐτὸς λόγος* . . ., but perhaps we ought to retain the asyndeton, in spite of its harshness. The writer's style, especially at the end of the treatise, is abrupt and compressed in the extreme. In l. 28 I read *εἰ ἡ τομὴ στιγμὴ* [so Z[a]: the other MSS. read *στιγμῆς*] *καί, ᾗ* [MSS. *ἡ*] *τομή, ἅπτεταί τινος,* and in l. 30 I accept Apelt's conjecture *καὶ ⟨τὸ ἐπίπεδον⟩ ἐκ γραμμῶν.*

If a line consists of points in contact, division of a line—the actual 'cut'—is itself a point, and (*quâ* dividing-point) is in contact with the adjacent points, or halves of a point, which it separates. But if so, we shall be led to the same absurdities as before (cf. 972[a] 24–27). Hence

(c) Neither[1] is it true to say of a point that it is 'the smallest constituent of a line'.

(i) For if it be called 'the smallest of the things contained in the line', what is 'smallest' is also *smaller* than those things

972b of which it is the smallest. But in the line there is contained nothing but points and lines: and the line is not bigger than the point, for neither is the plane bigger than the line.[2] Hence the point will not be the smallest of the constituents in the line.[3]

4 (ii) And if the point is comparable in magnitude with the line, yet, since 'the smallest' involves three degrees of comparison,[4] the point will not be the *smallest* of the constituents of the line: or[5] there will be other things in the length besides

we must not regard division as 'dividing a point', or as itself a 'point of dividing'. But if not, how can a line—which *ex hypothesi* is nothing but 'points in contact'—be 'divided'?

The writer then briefly reminds us that, if a line consists of points in contact, on the same principle a plane is a sum of lines, a solid a sum of planes, in contact with one another: and if we thus conceive solids and planes, 'the same argument' will apply to them. One plane, e.g., will be greater than another by a line, one solid greater than another by a plane, if we are able to 'subtract' a line from a plane, and a plane from a solid; and we shall get into difficulties with 'division'.

[1] a30 ff. We have seen that we must not predicate 'contact', 'addition', 'subtraction', or 'division' of the points in a line. In the following arguments the writer shows that we must not say of a point that it is 'the smallest constituent of a line'. No doubt he is attacking a current definition.

[2] a30–b3. The MSS. read *οὐκ ἀληθὲς δὲ κατὰ στιγμὴν εἰπεῖν, οὐδ' ὅτι τὸ ἐλάχιστον* [*ἐλαχίστη* L, *καὶ ἐλαχίστη* P, *καὶ ἐλάχιστον* Wa] *τῶν ἐκ γραμμῆς εἰς τὸ ἐλάχιστον* [*τὸ* om. L] *τῶν ἐνυπαρχόντων εἴρηται. τὸ δὲ ἐλάχιστον κτλ.*

The reading, which I have translated, is based on suggestions of Hayduck and Apelt: but I have altered Apelt's punctuation, and substituted *γ'* for *δέ* in l. 33. I read the whole passage thus:—*οὐκ ἀληθὲς δὲ κατὰ στιγμῆς εἰπεῖν, οὐδ' ὅτι τὸ ἐλάχιστον τῶν ἐν γραμμῇ. εἰ γὰρ τὸ ἐλάχιστον τῶν ἐνυπαρχόντων εἴρηται, τό γ' ἐλάχιστον, ὧν ἐστὶν ἐλάχιστον, καὶ ἔλαττόν ἐστιν. ἐν δὲ τῇ γραμμῇ κτλ.*

[3] b2–4. The writer assumes that *the other* constituents of the line, i.e. those presupposed in calling the point 'the smallest' constituent, are infinitesimal ('indivisible') lines: and the point is not smaller than these. The words in l. 3, *οὐδὲ γὰρ αὖ τὸ ἐπίπεδον τῆς γραμμῆς*, are obscure. Presumably we are to suppose that (according to the theory) just as the line consists of infinitesimal lines = points, so the plane consists of *planes-of-infinitesimal-breadth* = lines.

[4] b5. *ἐν τρισὶ προσώποις.* The word does not appear to be used in this sense elsewhere in Aristotle.

[5] b6. I read . . . *τῶν ἐν τῇ γραμμῇ ἐλάχιστον, ⟨ἢ⟩ καὶ ἄλλ' ἄττα ἐνυπάρξει* [so Hayduck for the MSS. *ἐνυπάρχει*] *παρὰ κτλ.* The insertion of *ἤ* seems

the points and lines, so that it will not consist of points.[1] But, since that which is in place is either a point or a length or a plane or a solid, or some compound of these: and since the constituents of a line are in place (for the line is in place): and since neither a solid nor a plane, nor anything compounded of these, is contained in the line:—there can be absolutely nothing in the length except points and lines.[2]

(iii) Further, since that which is called 'greater' than that which is in place is a length or a surface or a solid: then, since the point is in place, and since that which is contained in the length besides points and lines is none of the aforementioned: —the point cannot be the smallest of the constituents of a length.[3]

(iv) Further, since 'the smallest of the things contained in 17
a house' is so called, without in the least comparing the house with it, and so in all other cases:—neither will the smallest of the constituents in the line be determined by comparison with

to be required by the logic of the passage. The writer propounds a dilemma:—

(1) If there are only two kinds of constituent in the line, one of those kinds (viz. the point) cannot be the 'smallest';

(2) If, on the other hand, there are more than two kinds of constituent in the line, there must be something other than points and lines contained in it. This he shows to be impossible in the following argument.

[1] b8. I read *οὐκ ἄρ' ἐκ στιγμῶν*. If the MSS. reading (*οὐ γὰρ . . .*) be retained, we must translate 'For, on this supposition, it will no longer consist of points'.

In b7 *τῷ μήκει* is substituted for *τῇ γραμμῇ*. *γραμμὴ* is determinate *μῆκος*, *ἐπιφάνεια* determinate *πλάτος*, and *σῶμα* determinate *βάθος*, according to Arist. *Met.* 1020a 13.

[2] b8–13. In ll. 8, 9 I read with Hayduck *εἰ δὲ τὸ ἐν τόπῳ ὂν ἢ στιγμὴ ἢ μῆκος* [MSS. *ἡ στιγμὴ μῆκος*] *ἢ ἐπίπεδον ἢ στερεὸν* ⟨*ἢ*⟩ *ἐκ τούτων τι . . .*

[3] b13–17. In b14 I read with Hayduck *ἢ ἐπιφάνεια ἢ στερεόν* for the MSS. *ἡ ἐπιφάνεια στερεόν*.

The argument is:—The point is 'in place', i.e. a spatial thing. What is greater than the point, therefore, must be either a line or a plane or a solid. Now, in a length there can be contained neither plane nor solid. Hence there can *at most* be contained in a length one order of spatial thing (viz. line) which is greater than the point. Hence we are *at most* entitled to apply the comparative ('smaller'), and not the superlative ('smallest'), to the point in relation to the other constituents of the line.

It is possible, I think, that we should excise *εἰ* in b13, and read *ἔτι τοῦ ἐν τόπῳ κτλ.*

the line. Hence the term 'smallest' applied to the point will not be suitable.[1]

21 (v) Further, that which is not in the house is not the smallest of the constituents of the house, and so in all other cases. Hence, since the point can exist *per se*, it will not be true to say of it that it is 'the smallest thing in the line'.[2]

25 (d) Lastly, the point is not an 'indivisible joint'.[3]

For (i) the joint is always a limit of two things, but the point is a limit of *one* line as well as of two. Moreover (ii) the point is an end, but the joint is more of the nature of a division.

Again (iii) the line and the plane will be 'joints' ⟨too⟩: for they are analogous to the point. Again (iv) the joint *is* in a sense on account of movement (which explains the verse of Empedocles [4]): but the point is found also in the immovable things.[5]

(v) Again, nobody has an infinity of joints in his body or his hand, but he has an infinity of points.[6] (vi) Moreover,
31 there is no joint of a stone, nor has it any: but it has points.

[1] b17–21. In b18 I read *μή τι τῆς οἰκίας συμβαλλομένης πρὸς αὐτὸ λέγεται*. The MSS. give *μήτε τῆς κτλ.* Hayduck proposed *μὴ τῆς*, and Apelt conjectured *μήτε ⟨πρὸς τὴν οἰκίαν συμβάλλεται μήτε⟩ τῆς οἰκίας* . . . .

In b21 I follow Apelt in reading *ἐλάχιστον. ἔτι εἰ* for the MSS. *ἐλάχιστον, ἐπεὶ [ἐπὶ P]*. . . .

The writer seems to be meeting a possible objection. For it might be said: 'It is mere pedantry to object to the superlative. All we meant was that the point is smaller than the infinitesimal lines, or at any rate than the whole line.'

[2] b21–24. I read this passage as follows:—*ἔτι εἰ τὸ μὴ ὂν ἐν τῇ οἰκίᾳ μή ἐστι τῶν ἐν τῇ οἰκίᾳ ἐλάχιστον, ὁμοίως δὲ καὶ ἐπὶ τῶν ἄλλων, ἐνδέχεται δὲ* [so NW^{a}Z^a: the other MSS. read *γὰρ*] *στιγμὴν αὐτὴν καθ' αὑτὴν εἶναι, οὐκ ἔσται κατὰ ταύτης ἀληθὲς εἰπεῖν ὅτι τὸ ἐν γραμμῇ ἐλάχιστον. ἔτι δ' οὐκ κτλ.* [So Hayduck and Apelt: the MSS. read *ἐλάχιστον, ὅτι δὲ οὐκ*, or *ὅτι οὐκ*.]

The writer criticizes the definition on the ground that it assumes that the point is *essentially* a constituent of a line, i. e. has no being except in a line.

[3] b25. We must not describe the point as 'an indivisible joint'. We do not know who thus described it, but no doubt the writer is attacking a current description.

[4] b27–31. I read *ἀνάλογον γὰρ ἔχουσιν. ἔτι* [so Apelt, following W^a; the other MSS. have *ἔχουσιν, ὅτι*] *τὸ ἄρθρον διὰ φοράν* [so Apelt, for the MSS. *διαφορά* or *διάφορον*] *πως ἐστίν* . . . .

What the verse of Empedocles was, is unknown: the MSS. give '*διὸ δεῖ ὀρθῶς*', for which Diels (*Vorsokratiker*, 2nd ed., vol. 1, p. 184) brilliantly conjectures *δύω δέει ἄρθρον*, 'the joint binds two'.

[5] b30. The MSS. have *ἡ δὲ στιγμὴ καὶ τὸ ἐν τοῖς ἀκινήτοις*. The *τὸ* is unintelligible, and Hayduck is no doubt right in excising it.

[6] b31. The MS. L exhibits *στόματι* for *σώματι* in its margin. But this looks like a correction. The argument is *a fortiori*. 'In one's body—nay, even in one's hand—there are an infinity of points. . . .'

VENTORUM SITUS ET COGNOMINA

BY

E. S. FORSTER

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PREFACE

This short extract from the Peripatetic treatise *De Signis*, usually attributed to Theophrastus, is chiefly interesting for comparison with the charts of the winds given in the *Meteorologica* and *De Mundo*. The text used for this translation is that of O. Apelt,[1] who has in the main followed V. Rose's edition[2]; the latter is a great improvement on Bekker's text.

I have to thank Mr. W. D. Ross and my colleague, Professor W. C. Summers, for several suggestions.

[1] *Aristotelis quae feruntur De Plantis etc.* (Leipzig: Teubner, 1888).

[2] *Aristotelis quae feruntur librorum fragmenta* (pp. 199–201) (Leipzig: Teubner, 1886).

VENTORUM SITUS ET APPELLATIONES EX ARISTOTELIS LIBRO DE SIGNIS

BOREAS (the North Wind). At Mallus this wind is called 973^a Pagreus; for it blows from the high cliffs and two parallel ranges known as the Pagrean Mountains. At Caunus it is called . . .

Meses[1] (the North-North-East Wind). . . . In Rhodes it is known as Caunias; for it blows from Caunus, causing storms in the harbour of that place. At Olbia, near Magydum in Pamphylia, it is called Idyreus; for it blows from an island called Idyris. Some people identify Boreas and Meses, amongst them the Lyrnatians near Phaselis.

Caecias (the North-East Wind). In Lesbos this wind is called Thebanas; for it blows from the plain of Thebe, north of the Elaitic Gulf in Mysia. It causes storms in the harbour of Mitylene and very violent storms in the harbour of Mallus.[2] In some places it is called Caunias, which others identify with Boreas.

Apeliotes (the East Wind). This wind is called Potameus at Tripolis in Phoenicia; it blows from a plain resembling a great threshing-floor, which lies between the mountains of Libanus and Bapyrus; hence it is called Potameus.[3]

[1] 973^a 4. Meses must certainly be mentioned here as a separate wind, the NNE. wind: (1) unless a wind other than Boreas is described in ll. 3–9 the words *τινὲς δὲ αὐτὸν βορρᾶν οἴονται εἶναι* give no sense; (2) Meses is described in *Meteor.* 363^b 30 as a separate wind between Boreas and Caecias; (3) it is called Caunias at Rhodes, and Caunus is NNE. of Rhodes; (4) Meses is a very general term (see *Meteor.* 363^b–364^b *passim*) and would not be confined to Caunus. We must therefore suppose *lacunae* (such as occur also in this treatise at 973^b 11, 14, 15), and read *ἐν δὲ Καύνῳ . . . Μέσης ⟨οὗτος ἐν μὲν . . . καλεῖται . . . ,⟩ ἐν δὲ Ῥόδῳ κτλ.* Winds other than those at the main points of the compass are inserted, e.g. Thracias, 973^b 17.

[2] 973^a 11. Reading Μαλλόεντα.

[3] 973^a 16. The reason for this name does not seem obvious, unless this plain was called Potamus.

It causes storms at Posidonium.[1] In the Gulf of Issus and the neighbourhood of Rosus it is known as Syriandus; it blows from 'the Syrian Gates', the pass between [2] the Taurus and the Rosian Mountains. In the Gulf of Tripolis it is called Marseus, from the village of Marsus. In Proconnesus, Teos, Crete, Euboea, and Cyrene it is known as Hellespontias. It causes storms in particular at Caphereus in Euboea, and in the harbour of Cyrene, which is called Apollonia. It blows from the Hellespont. [At Sinope it is called Berecyntias, because it blows from the direction of Phrygia.][3] In Sicily it is known as Cataporthmias, because
973b it blows from the Straits. Some people identify it with Caecias, and also call it Thebanas.

Eurus (the South-East Wind). This wind is called Scopeleus at Aegae, on the borders of Syria, after the cliff [4] at Rosus. In Cyrene it is known as Carbas after the Carbanians in Phoenicia; wherefore some people call this same wind Phoenicias. Some people identify it with Apeliotes.

Euronotus [5] (the South-South-East Wind). Some call this wind Eurus, others Amneus.

Notus (the South Wind) bears the same name everywhere. It is derived from the fact that this wind is unwholesome, while out of doors it brings showers; thus there are two reasons for its name.[6]

Leuconotus (the 'white' or 'clearing' South Wind)

[1] 973a 16. Ποσείδιον, a harbour on the Syrian coast (Strabo, p. 751), should perhaps be read here.

[2] 973a 18. Reading αἷς for ἅς.

[3] 973a 24, 25. This passage is obviously misplaced. The east wind could not possibly be called Berecyntias at Sinope, because Sinope is east of Berecynthia. The statement should probably be transferred to Zephyrus.

[4] 973b 4. i.e. Σκοπελεύς from σκόπελος.

[5] 973b 6. 'Ορθόνοτος, the reading of the MS., can only mean 'the True South Wind', which seems superfluous, when νότος is mentioned immediately afterwards, nor would any confusion be likely to arise between 'the True South Wind' and Eurus. Rose suggests 'Ορθρόνοτος, 'the Morning South Wind,' a word not found elsewhere. Εὐρόνοτος seems to suit the sense better and is used in *Meteor.* 363b 22 and *De Mundo* 394b 33 for the wind between Eurus and Notus, i.e. the SSE. wind.

[6] 973b 8. i.e. two derivations are given for νότος, (1) νοσώδης, unhealthy, and (2) νότιος, damp (=κάτομβρος, showery).

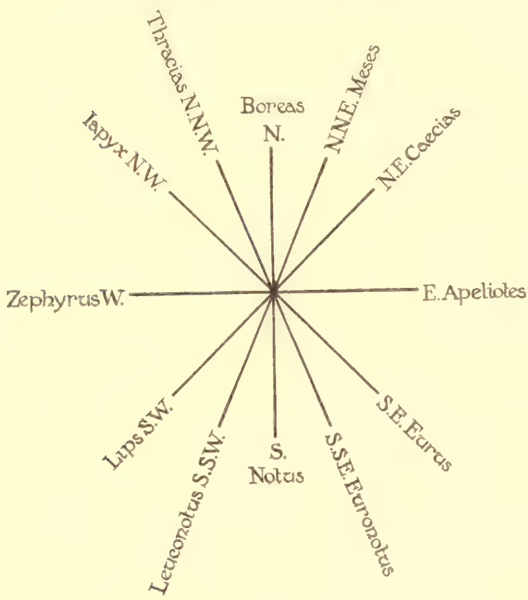
likewise derives its name from its effect; for it clears the sky.[1]

Lips (the South-West Wind). This wind gets its name from Libya, whence it blows.

Zephyrus (the West Wind). This wind is so named because it blows from the west, and the west . . .

Iapyx (the North-West Wind). At Tarentum it is called Scylletinus from the place Scylletium. At Dorylaeum in

Chart of the Winds to illustrate Aristotle, Ventorum Situs et Appellationes.[2]



Phrygia ⟨it is called⟩ . . . Some people call it Pharangites, because it blows from a certain ravine in Mount Pangaeus. Many call it Argestes.

Thracias (the North-North-West Wind) is called Strymonias in Thrace, for it blows from the river Strymon; in the Megarid it is known as Sciron, after the Scironian

[1] 973b 10. Leuconotus is apparently the SSW. Wind.

[2] For a chart of the various systems of winds in Aristot. *Meteor.* and *De Mundo* and in Seneca see W. Capelle, *Die Schrift von der Welt*, *Neue Jahrb.* xv. (1905) p. 542.

cliffs, in Italy and Sicily it is called Circias, because it blows from Circaeum. In Euboea and Lesbos it goes by the name of Olympias, which is derived from Pierian Olympus; it causes storms at Pyrrha.[1]

I have drawn the circle of the earth and indicated the positions of the winds, and the directions in which they blow, so that they may be presented to your vision.

[1] 973^{b} 23. The use of the *ethnicon* Πυρραῖοι instead of the place-name of Pyrrha in Lesbos is found also in Strabo (p. 617), *τὸν Πυρραίων εὔριπον*.

DE MELISSO XENOPHANE GORGIA

BY

T. LOVEDAY AND E. S. FORSTER

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INTRODUCTION

The date and authorship of this interesting treatise have been the subject of considerable controversy. Diels, its latest editor, whose text (Berlin, 1900) has been used for this translation, attributes it to an eclectic Peripatetic of the first century A.D. O. Apelt's text (Teubner, 1888) and Professor J. Cook Wilson's invaluable notes in his review of that edition (*C. R.* vols. vi and vii) have also been constantly before us.

Mr. W. D. Ross has read the translation both in manuscript and proof and made a number of valuable suggestions and emendations.

T. L.
E. S. F.

CONTENTS

DE MELISSO, XENOPHANE, GORGIA

DE MELISSO 974^a

I Melissus says that, if anything is, it is eternal, since it is impossible that anything can come into being from nothing. For suppose that either all things or some things have come into being, in either case they must be eternal; for otherwise, in coming into being, they would do so out of nothing. For if all things come into being, then nothing can pre-exist; whilst if some things were ever and others are added, that which is must have become more and greater, and that by which it is more and greater must have arisen out of nothing; for the more is not originally existent in the less, nor the greater in the smaller.

Being, since it is eternal, is unlimited; for it has no beginning from which it has come into being, and no end in which, when it comes into being, it can ever terminate.

Being all and unlimited it is one; for if it were two or more, these would be reciprocal limits.

Being one it must be similar throughout;[1] for if it were dissimilar, it would be several and therefore no longer one but many.

Being eternal and unlimited and alike throughout, the One is without motion; for it could not move without passing somewhere else, and it can only pass either into that which is full or into that which is empty; but of these the former could not admit it, while the latter is nothing at all.

Such being the nature of the One, it is unaffected by grief and pain, and is healthy and free from disease, and cannot change either by transposition[2] or by change of form[3] or by mixture with anything else; for under all

[1] This phrase is explained in 976^a 17 ff.

[2] i.e. of the elements, as the Atomists and others held.

[3] i.e. qualitative as distinct from quantitative change or change in the arrangement of particles.

these circumstances the One becomes many, and Not-being is necessarily generated and Being destroyed; but these are impossibilities. For, indeed, if it were maintained that any One is the result of a mixture of several constituents—suppose, that is, that things were many and moved into one another, and that their mixture were either by way of the composition of the many in one, or, being due to the constituents fitting in with one another, resulted in their covering one another from view—then in the former case the constituents mixed would be easily discernible, being distinct;[1] whilst, if they covered one another,[2] rubbing would reveal each constituent, the successive
974b layers being uncovered as the upper layers were removed.[3] Now neither of these things happens. But according to Melissus it is only in these ways that a Many could both be and also appear to us; and since these ways are impossible, that which is cannot be manifold, and the belief that it is manifold is erroneous, like many other fancies which are due to the senses; but argument does not prove either that things come into being or that what is, is many, but that it is one and eternal and unlimited and similar throughout.

Now surely one ought firstly to begin by taking not any and every opinion, but those which are most indisputable. If, then, all our opinions are incorrectly conceived, it is perhaps quite wrong to adopt this doctrine too, that nothing can ever come into being out of nothing; for this is but a single[4] opinion and an incorrect one too, which we somehow all of us[5] have often been led to conceive from our sense-perceptions. But if not all that appears to us is false, and some conceptions even of objects of sense are correct, either one ought to demonstrate the nature of such a correct conception and then adopt it, or else demonstrate and adopt those which appear most likely to be

[1] Reading with Kern χωρὶς ὄντα for χωρίζοντα (cf. 977a 6).
[2] Reading ἐπιπροσθέσεως.
[3] Omitting τῶν μιχθέντων which appears to have come in from above.
[4] i.e. an unsupported opinion.
[5] Reading πάντες with the Cod. Lips.: the change to πάντως seems quite unnecessary.

correct; and these must always be more indisputable than the conclusions which are apt to follow from the arguments of Melissus. For supposing that we really had to do with two contrary opinions, as Melissus thinks (his arguments show that he thinks so, viz. if there is a Many, it must needs arise from what is not; and if the consequent is impossible, what is, is not many; for, being ungenerated, anything which is, is unlimited, and therefore one), supposing this so, still, if we admit both propositions equally, unity is no more proved than multiplicity, and it is only if one proposition is more indisputable than the other, that the conclusions following from it are better proved. Now, as a matter of fact, we do entertain both these conceptions, namely, that nothing can come to be out of nothing, and also that existents are many and are in motion; and of the two the latter is more generally credited, and every one would more readily give up the former opinion than this. Now if it were the case that the two propositions are contrary to one another, and it were impossible that at the 975a
same time nothing should come to be out of Not-being, and there should be a multiplicity of things,[1] each of these views would refute the other. But why should his premisses be correct? Some one else might assert the exact opposite. For he has not argued his case either by showing that it is a correct opinion from which he starts, or by taking a more certain opinion than that with which his proof is concerned. For it is usually considered more likely that Being arises out of Not-being than that there is not a multiplicity of things; it is confidently asserted about existents that things which do not exist come into being, nay, often have come into being out of non-existents, and those who have asserted this are no ordinary men, but some of those who are looked upon as sages. To begin with, Hesiod says:

First of all in the world was Chaos born, and thereafter
Broad-bosomed earth arose, firm seat of all things for ever,
And Love that shineth bright amid the host of Immortals.[2]

[1] Reading with Cook Wilson ἀδύνατον μὴ γίγνεσθαι . . . καὶ πολλὰ εἶναι.
[2] *Theog.* 116–20.

All other things, he says, came into being from these, but these came into being out of nothing. Secondly, there are many who say that nothing is but all things become, declaring that whatever becomes does not arise from existents; for, if what becomes arose from existents, then their statement that all things become would be false. So much, therefore, is clear, that there are some people of the opinion that becoming even out of non-existents is possible.

But had we not better leave aside the possibility or 2
impossibility of his conclusions, and confine ourselves to what may very well be a distinct problem—namely, whether these conclusions follow from the premisses which he takes, or other conclusions might logically be derived from these premisses? And first of all, granted his first assumption, that nothing can come to be from Not-being, does it necessarily follow that all things are ungenerated? Or is there no reason why one thing should not have come to be out of another, and so on in an endless series? Or may it not go on in a circular process, in such a way that one thing has come to be out of another, there thus being always something in existence, and all things having come to be out of one another an endless number of times? In that case, although it be agreed that nothing can come to be out of Not-being, everything may very well have come to be. (And none of the attributes which are attached to the One prevents our calling existents unlimited in Melissus's sense of the word.[1] For he himself attributes to the unlimited that it actually is, and is synonymous with, all. And even if existents are not unlimited, there is no reason why they should not come to be by the circular process.[2]) Further, if all things come to be and nothing is, as some declare, how can they be eternal? Yet he certainly argues as though the existence of something were real and agreed. For, he says, if a thing has not come to be but is, it must be eternal, as though Being were necessarily inherent in

[1] πρὸς ἐκεῖνον, *ad Melissi sensum* (Diels).
[2] i.e. as described in 975^{a} 24–7.

things. Moreover, however impossible it may be for Not-being to come to be, or for Being to be destroyed, yet what prevents some existing things from having come to be and others from being eternal, as Empedocles also affirms? For after admitting all this, namely, that 975b

Out of that which is not can nothing come into being;
And whatsoever exists, no art nor device can destroy it;
For it will always abide, where'er 'tis implanted, for ever,[1]

he yet declares that of existents some are eternal, namely, fire, water, earth, and air, but that the rest of things come to be and have come to be out of these. For in his opinion there is no other process whereby existents can come to be,

Save the mingling of things and exchanging of things that are mingled;
This in the speech of men is called the work of Begetting.[2]

But he denies that the Being of the eternal things and of what really is, is the result of a process of coming to be; for this he considers impossible. For he says:

How could aught bring increase to the All and whence have arisen?[3]

But the Many come to be by the mixture and composition of fire and the other elements, and perish again when those elements are exchanged and separated; that is, by mixture and separation many things are at any time, but by nature there are only four[4] apart from the Causes,[5] or else only one.[6] Or again if these elements out of the composition of which things come to be, and by the dissolution of which they are destroyed, were from the first unlimited—which is what some affirm that Anaxagoras[7] means when he says that things which come to be do so out of things that are ever-existent and unlimited—even so not all things would be eternal, but there would be some things coming to be and having come to be from things that are, and

[1] Diels, *Vorsok.* 176, 24 ff.
[2] ib. 175, 17, 18.
[3] ib. 179, 9.
[4] i.e. the elements.
[5] i.e. Love and Strife, which Empedocles often reckons amongst the elements.
[6] i.e. the Sphere, but the words ἢ ἕν are perhaps to be rejected as a repetition of ἢ εἰ which follows.
[7] Diels, *op. cit.* 304, 30 ff.

passing by destruction into other modes of Being. Furthermore, there is no reason why one form should not constitute the All (as Anaximander[1] and Anaximenes say, the former declaring that the All is water, while Anaximenes says that it is air, and as others say who have contended along these lines that the All is one), and why this, by assuming various shapes and greater or less bulk—that is, by coming to be in a rare or dense state—should not make up the many unlimited objects which exist and come to be and compose the whole. Again, Democritus declares that water and air and each of the many things that exist are essentially the same, but differ in their rhythm.[2] Why should not the many come to be and be destroyed even in this way, the One changing continually from Being to Being by the above-mentioned differences, and the whole becoming not a whit either greater or less? Furthermore, why should not bodies from time to time come to be from other bodies and be dispersed into bodies, and thus by dissolution the processes of generation and decay always balance one another?

But if one were to make these concessions and allow that Being both exists and is ungenerated, how is its unlimitedness thereby more clearly demonstrated? For Melissus declares it to be unlimited, if it exists but has not come to be; for the beginning and end of the process of coming to be are, he says, limits. Yet what in his argument prevents a thing which is ungenerated from having a limit? For if a thing has come to be, he contends that it has as a beginning
976a that from which it began coming to be. Now why should it not have a beginning, even if it has not come to be—not, however, one from which it has come to be, but some other—and why should not existents, though eternal, be limited in relation to one another? Again, why should not the whole, being ungenerated, be unlimited, but the things which come to be within it be limited by having a beginning and end of coming to be? Again, as Parmenides says, what prevents the All, though it be one and

[1] Diels, *op. cit.* 14, 25. [2] i.e. shape, cf. *Metaphys.* 985b 16.

ungenerated, from being nevertheless limited and, to use his words,

> Like to the mass of a sphere on all sides carefully rounded,
> Everywhere equally far from the midst; for Fate hath appointed
> That neither here nor there should it either be greater or smaller?[1]

Now, if it has a centre and extremities, it has a limit though it is ungenerated; since if it be one and a body, as Melissus himself asserts, it has parts of its own as well, and these all alike. For when he says that the All is similar, he does not use the term of similarity to something else (this is just the point that Anaxagoras[2] raises in disproving that the unlimited is similar, i. e. that what is similar is similar to something else, so that being two or more it would no longer be one, nor yet unlimited), but perhaps he means similar in relation to itself—in other words, that it is composed of similar parts, being all water or earth or something else of the kind. For he clearly holds that in this case Being would be one; but each of the parts being a body is not unlimited (for it is the whole which is unlimited), and therefore they are limited in relation to one another, although they are ungenerated.

Further, if Being is both eternal and unlimited, how could it be one, being a body? For if it were composed of dissimilar parts, it would be many. Melissus himself contends that it would then[3] be many. But if it is all water or all earth, or whatever this Being is, it would have many parts (as Zeno, too, attempts to prove of that which is one in this sense); its parts would then be a manifold, being some of them smaller and less than others; so that in this way it would vary throughout without any body being added

[1] Diels, *op. cit.* 121, 4 ff.

[2] Reading Ἀναξαγόρας. Diels, following the Cod. Lips., reads Ἀθηναγόρας here in the text, while in his note he approves of Beck's emendation Ἀναξαγόρας, which he reads in *Vorsok.* 139 (cf. 304, 33). The sense is satisfactory, since Anaxagoras, while admitting only one infinite mass, admitted internal diversity. Cod. Rᵃ reads ὃ περαθῆναι ὁρᾷς ἐλέγχει εἴ τι κτλ., which Apelt emends to ὃ περανθὲν ἄν, ὁρᾷς, ἐλέγχει εἴ τι, and Cook Wilson to ᾧ περανθῆναι ἂν (ὁρᾷς) ἐλέγχοι εἴ τινι (*C. R.* vi. pp. 156–8).

[3] Reading with Apelt οὕτω γ' ⟨ἄν⟩.

to it or taken away from it. But if it has no body or width or length, how could the One be unlimited? Or why should there not be many, nay innumerable, existents of this kind? Further, if there are more existents than one, why should they not be unlimited in size, just as Xenophanes asserts that the depth both of the earth and of the air is unlimited? Empedocles shows that Xenophanes held this view; for, as though certain people urged such views, he makes the criticism that, if this is the nature of earth and air,[1] it is impossible for them ever to meet,

If the depths of the earth are unbounded and ample the ether,
As the words that come forth from the lips of mortals unnumbered,
Empty and meaningless, say; they have seen of the whole but a little.[2]

Further, if Being is one, there is nothing absurd in supposing that it is not similar everywhere. For if the All
976b is water or fire or something of that kind, there is no reason why we should not suppose several kinds of this one Being, each kind individually similar to itself.[3] For there is no reason why one kind should not be rare and another dense, as long as the rarity does not involve a void. For in the rare there is not a void isolated in particular parts in such a way that of the whole part is dense and part empty[4] (rarity then meaning that the whole is like this); but rarity is produced when the whole is uniformly full, but uniformly less full than in the dense.

But suppose Being exists and is ungenerated, and suppose it were granted that for this reason it is unlimited, and that more than one thing cannot be unlimited, and it must therefore be said to be one, and it is impossible for it to be dissimilar—how can he say that the whole is without motion, if the void cannot exist?[5]

[1] *ἐχόντων, sc. γῆς καὶ ἀέρος* (Mullach).

[2] Diels, *op. cit.*, 187, 4 ff.

[3] i.e. homogeneous.

[4] Reading with Bonitz τὸ μὲν πυκνόν, ⟨τὸ δὲ κενόν⟩.

[5] The reading of this passage is extremely doubtful and probably too corrupt for anything like certain emendation. Cook Wilson (*l. c.* pp. 159, 160) shows conclusively that the criticism of the fifth thesis

Now Melissus declares that Being is without motion, if a void does not exist; for everything moves by changing its place. In the first place, then, this does not agree with the opinion of many, which is that a void does exist, yet it is not a body, but is of the nature of the Chaos, as Hesiod describes it first coming into being in the birth of things, considering space to be a prime necessity for things which exist; and the void is, as it were, a vessel in which we expect to find an interior space.[1] But even if there is no void, why should Being be less likely to move? For Anaxagoras, who devoted his attention to this subject, and for whom it was not enough merely to declare that a void does not exist, declares that things which are, are in motion, although there is no void. Similarly Empedocles says that they are ever in motion continually all through the period of aggregation, but that there is no void; for he says that

> Nought of the whole can be void; whence then could any be added? [2]

while when all has been aggregated into a single form, so as to be one,

> Emptiness there is none, nor aught that is overflowing.[3]

For why should not things assume one another's position and go through a circle of simultaneous movements, one thing taking the place of another, and that the place of something else, and something else the first position? And what is there in what he has said that precludes a movement taking place in things, consisting in a change of form in an object which remains in the same position (what he, like every one else, terms 'alteration'), as, for example, when white turns into black, or bitter into sweet? For the non-existence of a void and the inability of that

of Melissus, *ἀκίνητον εἶναι τὸ ἕν*, begins at *εἰ δὲ καὶ ἔστιν*, and that it is introduced, as are the discussions of the other theses, by a hypothetical clause. His suggested reading, adopted here, has the advantage that it makes the sense clear, viz.: *καὶ διὰ τοῦτο ἄπειρον ⟨ἂν⟩ δοθείη εἶναι καὶ μὴ ἐνδέχεσθαι ἄλλο καὶ ἄλλο ἄπειρον εἶναι, ⟨καὶ⟩ διὰ τοῦτο καὶ ἓν προσαγορευτέον, καὶ ἀδύνατον ⟨εἶναι ἀνόμοιον⟩, πῶς ἂν ⟨εἴ⟩η ἀκίνητον τὸ ὅλον εἰ τὸ κενὸν μὴ οἷόν τ' εἶναι;*

[1] Cf. *Phys.* 212a 14. [2] Diels, *op. cit.*, 177, 1. [3] ib. 176, 30.

which is full to receive any addition does not at all preclude the possibility of alteration.

Thus neither are all things necessarily eternal nor is Being necessarily unlimited (but many things are unlimited), nor is it one, nor homogeneous, nor unmoved, whether it be one or whether it be many. If this is admitted, there would be nothing in what he has said to prevent existents from being either transposed or altered; if Being is one, 977a the movement is of the whole, which differs in density and rarity, and alters without the addition or abstraction of any body; while, if there is a multiplicity of existents, their movement is due to their mutual mixture and segregation. For it is not likely that the process of mixture is either a placing of elements one above another,[1] or a putting of them together, such as he supposes,[2] by which either they are immediately distinct, or else they appear each distinct from one another, if the layers above one another are successively rubbed away; but they are so arranged in their mixture, that any part of that which is mixed comes into such a relation to any part of that with which it is mixed, that even the smallest particles would be found not merely placed together but mixed. For since there is no smallest body,[3] every part is mixed with every other part, just as the whole is mixed.

DE XENOPHANE

Xenophanes declares that if anything is, it cannot 3
possibly have come into being, and he argues this with reference to God. For that which has come into being must necessarily have done so either from that which is similar or from that which is dissimilar; and neither alternative is possible. For it is no more possible for like to have been begotten by like than for like to have begotten like (for at any rate when similars are equal, all the same

[1] Reading ἐπιπρόσθεσιν. [2] Cf. 974a 26 ff.
[3] i.e. there is no *minimum corporeale*; something can always be found smaller than what any one calls the smallest.

qualities inhere in each and in a similar way in their relations to one another), nor could unlike have come into being from unlike. For if the stronger could come into being from the weaker, or the greater from the less, or the better from the worse, or reversely worse things from better, then Not-being could come to be from Being, or Being from Not-being; which is impossible. Accordingly for these reasons God is eternal.

Now if God is supreme over all, Xenophanes declares that it follows that he must be one. For if there were two or more gods, he would no longer be supreme and the best of all; for then each of the many gods would likewise be supreme. For what God and God's power means is that he is supreme and never inferior, and that he possesses supremacy over all. So far then as he is not superior, he is not God. Now if there were several gods, supposing they were superior to one another in some respects and inferior in others, they would not be gods; for it is the nature of the divine not to be inferior. But supposing they were equal, they would not possess God's nature, for God must be supreme; whereas that which is equal is neither better nor worse than that to which it is equal. So that if God be, and be of this nature, God is one and one only. For otherwise he could not even do whatsoever he wished; for if there were more gods than one, he could not do so; therefore he is One only.

Being one he is similar in every part, seeing and hearing and possessing the other senses in every part of him. For otherwise the parts of God would be superior and inferior to one another; which is impossible.

Being similar in every part, he is spherical; for he is 977b
not of a certain nature in one part and not in another, but in every part.

Being eternal and one and similar and spherical, he is neither unlimited nor limited. For Not-being is unlimited; for it has neither middle nor beginning and end, nor any other parts, and such is the nature of the unlimited. But Being could not be of the same nature as Not-being. On the other hand, if things were several, mutual limitation would occur. But the One has no likeness either to Not-being or to the Many; for that which is one has nothing in which it can find a limit.

A One, then, of the kind which Xenophanes declares God to be can, he says, be neither moved nor unmoved; for immobility belongs to Not-being (for nothing else can go into it, nor can it go into anything else); while movement belongs to a plurality, for one body must move into another's place. Now nothing can ever move into Not-being; for Not-being is nowhere. On the other hand, if it moved in the way of things changing into one another, then the One would be more than one. For these reasons motion belongs to a pair of things, or any number more than one, while rest and immobility belong to that which is nothing. But the One is neither still nor is it moved; for it is similar neither to Not-being nor to the Many; but being in every respect of this nature—eternal and one and similar and spherical—God is neither unlimited nor limited, neither at rest nor in motion.

In the first place, then, Xenophanes also, like Melissus, 4
assumes that what comes into being does so from that which already is. Yet why should not that which comes into being do so not from something either similar or dissimilar, but from Not-being? Further, God is no more ungenerated than anything else, even if we suppose that all things have come into being from something similar or dissimilar, which is impossible; so that either there is nothing except God or everything else is also eternal. Further, he assumes that God is supreme, meaning by this that he is most powerful and best. This does not seem to agree with the customary opinion, which holds that some gods are in many respects superior to others. It was not, therefore, from accepted opinion that he took this hypothesis about God, which he treats as though it were admitted. It is said that he understands the supremacy of God in the sense that his nature is superior, not in relation to anything else, but in his own disposition; since surely in relation to something else there would be nothing to

prevent his excelling, not by his own goodness and strength, but owing to the weakness of all others. But no one would wish to say that God is supreme in this latter sense, but rather that he is in himself as excellent as possible, and there is nothing lacking in him of what is good and noble; if this is so, his supremacy would perhaps follow. But even if there are more gods than one, nothing would prevent their being of this nature, all possessing the greatest possible 978a
excellence and being superior to all else, but not to one another. Now there are, it seems, other things besides God; for he says that God is supreme, and he must necessarily be supreme over something.

But[1] supposing that he is one, it does not follow that he sees and hears in every part; for if he does not see in one part, he does not see worse in that part, but does not see at all. But perhaps perceiving in every part means that he would possess the highest excellence if he were similar in every part.

Further, if this were his nature, why should he be spherical, and why should he have that shape rather than any other, just because he hears in every part and is supreme in every part? For just as when we say of white lead that it is white in all its parts, we merely mean that the colour whiteness is present in every portion of it, why should we not say similarly of God that sight and hearing and supremacy are present in every part, in the sense that whatsoever portion of him one takes will be found to be possessed of these characteristics? But God is not necessarily spherical for this reason any more than white lead is.

Further, how is it possible that, being a body and having magnitude, God can be neither unlimited nor limited? For that is unlimited which, being capable of limitation, has no limit, and limit occurs in magnitude and multitude and any kind of quantity; and therefore any magnitude which has no limit is unlimited. Again, if God is spherical, he must have a limit; for he has extremities, if he has a centre within himself from which they are at the greatest

[1] Reading δέ with Mullach and Apelt and putting a full stop before ἕνα.

distance. But anything which is spherical has a centre; for that is spherical in which the extremities are equidistant from the centre. Now it is the same thing to say that a body has extremities, and that it has limits . . .[1] For if Not-being is unlimited, why should not Being also be unlimited? For why should not some identical attributes be assigned to Being and to Not-being? For no one can perceive at this moment what does not exist, while something may exist at this moment without any one's perceiving it;[2] yet both can be the subject of speech and thought . . .[3] And the non-existent is not white; either, then, for this reason existents are all white (this is in order that we may not assign an identical quality to that which exists and to the non-existent), or else, I think, there is nothing to prevent anything which exists from being not white. And so Being would still more easily admit a negative predicate, namely, the unlimited, if, as was said just now,[4] a thing is unlimited owing to its not having a limit;[5] and so Being too is either unlimited or has a limit. But perhaps to attribute unlimitedness to Not-being is also absurd; for we do not call everything which has not a limit unlimited, just as we should not say that what is not equal is unequal. Again, why should not God, although he be one, yet be limited, though not by any-
978b thing which is God. But if God is a sole one, then his parts also must be a sole one.[6] Further, it is also absurd that if in fact the Many are limited in relation to one another, for this reason the One should not have a limit. For many of the same predicates belong to the Many and to the One; Being, for instance, is common to them both. It would therefore, perhaps, be absurd if we were to declare

[1] Diels marks a lacuna here.

[2] This passage is corrupt: the above is a translation of Apelt's emendation, τό τε γὰρ οὐκ ὂν οὐδεὶς νῦν αἰσθάνεται, καὶ ὂν δέ τι (*sic* Cook Wilson, Apelt reads τις) οὐκ ἂν αἰσθάνοιτο νῦν.

[3] Diels marks a lacuna; the following words οὐ λευκόν τε are probably corrupt.

[4] i.e. in l. 17.

[5] The whole sentence is corrupt, and Diels's emendation ('*ut potui emendavi*') not very convincing. In *Vorsok.* (p. 38) he brackets τὸ ἄπειρον. The whole passage is fully discussed by Cook Wilson, *Class. Rev.* vi. 210 ff.

[6] This seems pointless: Cook Wilson suggests οὐχ ἓν ἂν εἴη μόνον.

that God does not exist for the reason that the Many exist, so that he may not be like[1] them in this respect. Again, though God be One, why should he not be limited and have limits? even as Parmenides says that, being One, he is

Like to the mass of a sphere on all sides carefully rounded
Everywhere equally far from the midst.[2]

For the limit must be a limit of something, but not necessarily in relation to something else: that which has a limit does not necessarily have it in relation to something else (as when it is limited in relation to the unlimited which comes next to it),[3] but being limited means the possession of extremities, and when a thing has extremities it need not necessarily have them in relation to something else. Some things, therefore, may happen both to be limited and to adjoin something else, while others may be limited, but not in relation to something else.

Again, as regards Being and Not-being being unmoved, we must say that to suppose that Not-being is unmoved because Being is moved, is perhaps just as absurd as the cases of opposition given above.[4] And further, surely one cannot suppose that 'not-moving' and 'unmoved' are the same thing, but the former is the negation of moving (like 'not-equal', which can be correctly used even of the non-existent), while 'unmoved' is used of an actual state (as 'unequal' is used), and to express the contrary of 'moving' (that is, 'being at rest'), just as words with the negative prefix[5] are generally used to express contraries. It is therefore quite right to use the term 'not-moving' of the non-existent, but 'being at rest' cannot belong to the non-existent; similarly 'unmoved', which means the same thing,[6] cannot belong to it. Yet Xenophanes uses 'not moving' in the sense of 'being at rest', and says that Not-being is at rest because it undergoes no change of

[1] Reading ὅμοιος.
[2] Diels, *op. cit.*, 121, 4, 5.
[3] These words, as Cook Wilson points out, do not seem to contain any meaning.
[4] i.e. in 978a 28 ff.
[5] i.e. Greek words which have the 'α privative' prefix.
[6] Reading with Apelt, οὐδὲ ἀκίνητον εἶναι, ⟨ὃ⟩ σημαίνει ταὐτόν.

position. As we said above, it is perhaps absurd, if we attach some predicate to Not-being, to assert that it does not apply to Being, especially if the predicate used is a negation, such as ' not moving ' and ' not changing its position '. For, as has been said, it would preclude a number of predicates from being used of existing things : for it would not be true to say that ' many ' is ' not one ', since the non-existent also is ' not one '. Furthermore, in some cases the contrary predicates seem to follow from the mere[1] negations ; for example, a thing must be either equal or unequal if it is a multitude or magnitude, and odd or even, if it is a number ; similarly, perhaps, Being, if it be a body, must be either at rest or in motion. Further, if God and the One do not move, just because
979a the Many move by passing into one another, why should not God also move into something else ? For he nowhere states that God is one and sole, but what he says is that there is only one God. But even supposing God were one and sole, why should not the parts of God move into one another and God himself thus revolve ? For he will not, like Zeno, declare that such a One is many. For he himself asserts that God is a body, whether he calls it the All or by some other name ; for if he were incorporeal, how could he be spherical ? Again, it would only be possible for him neither to move nor to be at rest if he were nowhere ;[2] but since he is a body, what would prevent this body from moving, in the way mentioned ?

DE GORGIA

GORGIAS declares that nothing exists ; and if anything 5
exists it is unknowable ; and if it exists and is knowable, yet it cannot be indicated to others. To prove that nothing exists he collects the statements of others, who in speaking about Being seem to assert contrary opinions (some trying to prove that existence is one and not many,

[1] Reading with Cook Wilson αὐτὰς τὰς ἀποφάσεις.
[2] Putting a colon after μηδαμοῦ γε ὤν.

others that it is many and not one, and some that existents are ungenerated, others that they have come to be), and draws a two-edged conclusion. For he argues that if anything exists, it must be either one or many, and either be ungenerated or have come to be. If therefore, it cannot be either one or many, ungenerated or having come to be, it would be nothing at all. For if anything were, it would be one of these alternatives. That Being, then, is neither one nor many, neither ungenerated nor having come to be, he attempts to prove by following partly Melissus and partly Zeno, after first stating his own special proof that it is not possible either to be or not to be. For, he says, if Not-to-Be is Not-to-Be, then Not-being would *be* no less than Being. For Not-being *is* Not-being and Being *is* Being, so that things no more are than are not. But if Not-to-Be *is*, then, he argues, To-Be, its opposite, is not; for if Not-to-Be is, it follows that To-Be is not. So that on this showing, he says, nothing could be, unless To-Be and Not-to-Be are the same thing. And if they are the same thing, even so nothing would be; for Not-being is not, nor yet Being, since it is the same as Not-being. Such, then, is his first argument.

6 Now it does not at all follow from what he has said that nothing is. For the proof which he and others attempt is thus refuted: If Not-being is, it either 'is' simply, or else it is in a similar sense because it is non-existent. But this is not self-evident, nor a necessary deduction; but if there are, as it were, two things of which one is and the other is not, you can truly say of the former that it 'is', but not of the latter, because that which is, is existent, but that which is not is non-existent.[1] Why, then, is it 979b

[1] 979a 35–979b 1. The following appears to be the argument if *διελέγχεται* is accepted: If you say *τὸ μὴ ὂν ἔστι*, you may say 'it is' simply, or you may say it is (in a similar sense) because it is *μὴ ὄν*: that is, you may say 'it is' existentially *from the outset*, or you may proceed to the existential sense from the copulative sense in which you say *τὸ μὴ ὄν ἐστι μὴ ὄν*. *ὁμοίως* then means 'in a similar sense to that in which you say *ἔστιν ἁπλῶς*.' *τοῦτο* will refer to the last preceding clause, i.e. it is not self-evident nor a necessary deduction to proceed from *ἐστί* in the copulative to *ἔστι* in the existential sense; rather *δυοῖν*

not possible either to be or not to be? And why should not both or either be possible? For, he says, Not-to-Be, if Not-to-Be were, as he thinks, something, would *be* just as much as To-Be, while at the same time he denies that Not-to-Be has any kind of existence.[1] But even if Not-being is Not-being, yet it does not follow that Not-being 'is' in a similar way to Being; for the former is Not-being, while the latter actually is as well.[2] But even if he could say of Not-being that it is simply (yet how strange it would be to say that 'Not-being is!'), still granted that it were so, does it any more follow that everything is not rather than is? For the exact opposite seems then to become the consequent; since, if Not-being is Being and Being is Being, all things are; for both the things which are, and the things which are not, are. For it does not necessarily follow that if Not-being is, Being is not. Even if one were to concede the point and allow that Not-being is and Being is not, nevertheless, something would be; for the things which are not would be, according to his argument. But if To-Be and Not-to-Be are the same thing, even so it would not follow that nothing is, rather than that something is. For just as he argues that if Not-being and Being are the same thing, Being and Not-being alike are not, therefore nothing is; so, reversing the position, it is equally possible to argue that everything is; for Not-being is and Being is, therefore everything is.

After this argument Gorgias declares that if anything is, it must either be ungenerated or else have come to be. If it is ungenerated, he adopts the tenet of Melissus that it is unlimited, and declares that the unlimited cannot exist anywhere. It cannot, he argues, exist in itself, or

ὄντων, τοῦ μὲν ὄντος, τοῦ δ' οὐκ ὄντος, you can truly say of the former "*ἔστιν*" (*ἁπλῶς*), but of the latter "*οὐκ ἔστι*", because the former (if you insert a copula) *ἐστὶν ὄν*, but the latter *ἐστὶ μὴ ὄν*, and, of course, you can proceed from "*ἐστὶν ὄν*" to "*ἔστιν*" (*ἁπλῶς*), which means the same thing, but not from "*ἐστὶ μὴ ὄν*" to "*ἔστιν*" (*ἁπλῶς*), which means the opposite. What then is his justification for saying *οὐκ ἔστιν οὔτ' εἶναι οὔτε μὴ εἶναι*?

[1] Reading with Cook Wilson *οὐδέν* for *οὐδείς*.

[2] i. e. Being not only is Being ('is' in the copulative sense), but it further (*ἔτι*) 'is', that is, has real existence ('is' in the existential sense).

in anything else (for, on the latter supposition, there would be two unlimiteds, that which is in something else and the something else in which it is); and, being nowhere, it is nothing, according to the argument of Zeno about space. Being is not, therefore, ungenerated. Nor, again, has it come to be; for, surely, he argues, nothing could come to be out of either Being or Not-being. For if Being were to change, it would no longer be Being,[1] just as also, if Not-being were to come to be, it would no longer be Not-being. Nor, again, could it come to be, save from Being; for if Not-being is not, nothing could come to be out of nothing; while on the other hand, if Not-being is,[2] it could not come to be out of Not-being for the same reasons for which it could not come to be out of Being. So if anything that is, necessarily either is ungenerated or else has come to be, and these are impossibilities, it is impossible for anything to be.

Further, if anything is, either one or more things must be; if neither one nor more, nothing is . . .[3]

Nor, he says, can anything move. For if it were to move 980a
it would no longer be in the same condition, but Being would be Not-being, and Not-being would have come to be. And further, if it moves and is transferred to a different position, Being, being no longer continuous, is divided, and, where it is divided, it no longer exists; and so, if it moves in all its parts, it is divided in all its parts, and if

[1] Keeping the MS. reading *τὸ ὄν*.

[2] Reading *εἰ δ' ἔστιν αὖ τὸ μὴ ὄν*.

[3] 979b 36–980a 1. These lines are hopelessly corrupt in the MSS., which show various lacunae. Diels prints the text of Cod. Lips. with the lacunae there shown. Apelt restores as follows: *καὶ ἓν μὲν οὐκ ἂν εἶναι, ὅτι ἀσώματον ἂν εἴη τὸ ὡς ἀληθῶς ἕν, καθὸ οὐδὲν ἔχον μέγεθος. ὃ ἀναιρεῖσθαι τῷ τοῦ Ζήνωνος λόγῳ. ἑνὸς δὲ μὴ ὄντος οὐδ' ἂν ὅλως εἶναι οὐδέν. μὴ γὰρ ὄντος ἑνὸς μηδὲ πολλὰ εἶναι δεῖν. εἰ δὲ μήτε ἕν, φησίν, μήτε πολλὰ ἔστιν, οὐδὲν ἔστιν.* This gives good sense and fits in with the fragments as shown in the Cod. Lips.: the only objection is the word *ἀναιρεῖσθαι*, of which there is no indication in the Cod. Lips. and which is too long for the space; a more natural word would be *λαμβάνει*, cf. 979b 22. Apelt's text, with this alteration, may be translated: 'One cannot be, because the true One would be incorporeal, as having no magnitude. (This he adopts from the tenets of Zeno.) And if one is not, nothing can be at all; for if one is not, many cannot be either; and if neither one nor many are, nothing is.'

this is so, it ceases to exist in all its parts. For where it is divided, he argues, there it lacks Being; he uses 'divided' to mean a void, as is written in the so-called 'Arguments of Leucippus'.

These are the proofs which he employs to show that nothing exists; he next goes on to prove that if anything exists it is unknowable.[1] For otherwise, he argues, all objects of cognition must exist, and Not-being, if it really does not exist, could not be cognized either. But were this so, nothing could be false, not even (he says) though one should say that chariots are racing on the sea. For all things would be just the same.[2] For the objects of sight and hearing are[3] for the reason[4] that they are in each case cognized. But if this is not the reason—if just as what we see is not the more because we see it, so also what we think is not the more for that[5] (and, were it otherwise, just as in the one case our objects of vision would often be just the same,[6] so in the other our objects of thought would often be just the same[6]) . . . ; but of which kind the true things are is uncertain. So that even if things are, they would be unknowable by us.

But even if they are knowable by us, how, he asks, could any one indicate them to another? For how, he says, could any one communicate by word of mouth that which he has seen? And how could that which has been seen be indicated to a listener if he has not seen it?
980b For just as the sight does not recognize sounds, so the hear-

[1] Reading with Apelt, *εἶναι οὖν οὐδέν, τὰς ἀποδείξεις ⟨λέγει ταύτας. εἰ δ' ἔστιν, ὅτι ἄγνωστόν ἐστι, μετὰ ταῦτα τὰς ἀποδείξεις⟩ λέγει.*

[2] Sc. true and false indistinguishable. Apelt reads *ταύτῃ*.

[3] Or 'will be' if Apelt's *ἔσται* be accepted.

[4] Omitting Diels's interpolation.

[5] Punctuating with a comma at *διανοούμεθα*, and taking *εἰ δὲ μὴ . . . διανοούμεθα* as the protasis, *καὶ γὰρ ὥσπερ . . . διανοηθείημεν* as an argument in support of the protasis, and the corrupt clause *τὸ οὖν κτλ.* as the apodosis. But the sense of the whole passage is very obscure. With Diels's text it is difficult to assign a single meaning to *φρονεῖσθαι* throughout (i.e. *either* cognition—apprehension—generally, *or* thought—including imagination—specifically as opposed to perception). Reference should be made to Cook Wilson's treatment of the passage (*Class. Rev.* vii. 33 ff.), which involves considerable changes in the text, but results in an intelligible meaning.

[6] i. e. true and false indistinguishable.

ing does not hear colours but sounds; and he who speaks, speaks, but does not speak a colour or a thing. When, therefore, one has not a thing in the mind, how will he get it there from another person by word or any other token of the thing except by seeing it, if it is a colour, or hearing it, if it is a noise? For he who speaks does not speak a noise at all, or a colour, but a word; and so it is not possible to conceive a colour, but only to see it, nor a noise, but only to hear it. But even if it is possible to know things, and to express whatever one knows in words, yet how can the hearer have in his mind the same thing as the speaker? For the same thing cannot be present simultaneously in several separate people; for in that case the one would be two. But if, he argues, the same thing *could* be present in several persons, there is no reason why it should not appear dissimilar to them, if they are not themselves entirely similar and are not in the same place; for if they were[1] in the same place they would be one and not two. But it appears that the objects which even one and the same man perceives at the same moment are not all similar, but he perceives different things by hearing and by sight, and differently now and on some former occasion; and so a man can scarcely perceive the same thing as someone else.

Thus nothing exists; and if anything could exist, nothing is knowable; and even if anything were knowable, no one could indicate it to another, firstly because things are not words, and secondly because no one can have in his mind the same thing as someone else. This and all his other arguments are concerned with difficulties raised by earlier philosophers, so that in examining their views these questions have to be discussed.[2]

[1] Reading with the Cod. Lips. *εἴησαν*.
[2] The text here is corrupt, but the sense agrees.

INDEX

Aud. = de Audibilibus.
Col. = de Coloribus.
Lin. = de Lineis Insecabilibus.
Mech. = Mechanica.
Mir. = de Mirabilibus Auscultationibus.
MXG. = de Melisso Xenophane Gorgia.
Ph. = Physiognomonica.
Pl. = de Plantis.
Vent. = Ventorum situs et cognomina.

91^a–99^b = 791^a–799^b. 0^a–58^b = 800^a–858^b. 68^a–80^b = 968^a–980^b.

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